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Software Test Description (STD) for the Globally Relocatable Navy Tide/Atmospheric Modeling System (PCTides)

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14. ABSTRACT

The purpose of this Software Test Description (STD) is to establish formal test cases to be used by personnel tasked with the installation and verification of the Globally Relocatable Navy Tide/Atmospheric Modeling System (PCTides). This STD describes the test and evaluation criteria necessary to verify that the PCTides software has been properly implemented. Three test cases have been selected to exercise the software. The test inputs, expected results, criteria for evaluation of those results, and assumptions regarding the test itself are described. This document, along with the Software Requirements Specification (Preller et al., 2001) and the Software Design Description (Hubbert et al., 2001) form the standard documentation package for the OAML PCTides.

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SOFTWARE TEST DESCIPTION (STD) FOR THE GLOBALLY RELOCATABLE NAVY TIDE/ATMOSPHERIC MODELING SYSTEM (PCTIDES)

1.0 Scope

This Software Test Description (STD) establishes formal test cases to be used by personnel tasked with the installation and verification of the Globally Relocatable Navy Tide/Atmosphere Modeling System (PCTides).

1.1 Identification

PCTides is a high resolution hydrodynamic model that characterizes coastal flooding due to storm surges. It consists of a Mesoscale Atmospheric Prediction System (MAPS) and the Coastal Ocean Model (GCOM2D and GCOM3D), a 2- and 3-dimensional barotropic ocean model developed by the Global Environmental Modeling Services (GEMS). The PCTides products can be used in sea state and tidal forecasting, disaster planning and management, and coastal engineering and storm impact studies (Hubbert and McInness, 1999).

MAPS is a hydrostatic primitive equations model used to provide high resolution spatial representation of anemometer level winds and surface pressure field as atmospheric boundary conditions for the 2- or 3-dimensional barotropic ocean models (GCOM2D/3D). A turbulence closure scheme has been designed to allow the model to be run with its lowest model level at anemometer height, providing direct simulation of winds at this level. MAPS is capable of being run on varying spatial resolution anywhere in the globe.

GCOM2D is a depth-integrated shallow water model designed to model currents and sea levels on or near continental shelves. It features a wetting and draining algorithm for the simulation of coastal flooding due to tides or storm surge. GCOM3D is the three-dimensional counterpart of GCOM2D. It is a barotropic model for applications where current structure with vertical depth is required and tidal and wind forcing are dominant. In tropical applications, atmospheric forcing for GCOM2D/3D is provided by a hurricane vortex model rather than by MAPS.

1.2 Document Overview

This Software Test Description describes the test and evaluation criteria necessary to verify that the PCTides software has been properly implemented. Three test cases have been selected to exercise the software.

The test inputs, expected results, criteria for evaluation of those results, and assumptions regarding the test itself are described. This document has been prepared in accordance with the Software Documentation Standards for Environmental System Product Development, released in January 1999 and distributed by NAVOCEANO.

Manuscript approved April 22, 2002.

2.0 References

2.1 Software Documentation Guidelines

Oceanographic and Atmospheric Master Library Summary. Naval Oceanographic Office, System Integration Department. OAML-SUM-21F. April, 1998.

Software Documentation Standards for Environmental System Product Development. Naval Oceanographic Office, System Integration Department. OAML-SDS-59A. January, 1999.

2.2 PCTides Software Release

Hubbert, G.D., Preller, R.H., Posey, P.G., and Carroll, S.N. (2001). Software Design Description (SDD) for the Globally Relocatable Navy Tide/Atmosphere Modeling System (PCTides). NRL Technical Memo NRL/MR/7322—01-8266.

Preller, R.H., Posey, P.G., Carroll, S.N., and Orsi, L.B. (2001). Software Requirements Specification (SRS) for the Globally Relocatable Navy Tide/Atmosphere Modeling System (PCTides). NRL Technical Memo NRL/MR/7322—01-8265.

Preller, R.H., Posey, P.G., Hubbert, G.D., Carroll, S.N., and Orsi, L.B. (2001). User's Manual for the Globally Relocatable Navy Tide/Atmosphere Modeling System (PCTides). NRL Technical Memo NRL/MR/7322—01-8268.

2.3 General Technical Documentation

Hubbert, G.D. and K.L. McInnes, (1999): A storm surge inundation model for coastal planning and impact studies. *J. Coastal Research.* **15**. 168-185.

Shum, C.K., Woodworth, P.L., Andersen, O.B., Egbert G.D., Francis, O., King, C., Klosko, S.M., Le Provost, C., Li, X., Molines, J.-M., Parke, M.E., Ray, R.D., Schlax, M.G., Stammer, D., Tierney, C.C., Vincent, P., and Wunsch, C.I., (1997) Accuracy Assessment of Recent Ocean Tide Models. *J. Geophys. Res.*, **102**: 25173-25194.

3.0 Test Preparations

Three complete test cases are provided to exercise the installed PCTides capability. These are delivered along with the PCTides software, including sufficient input data files for the user to replicate the results shown here. It is assumed that the PCTides software has been installed, according to separate instructions, before attempting these runs.

3.1 Hardware Preparation

The execution of PCTides does not require extensive hardware configuration or modification and can be easily loaded onto either the PC Windows/DOS or UNIX operating systems. In order to successfully execute PCTides there must be at least 256 MB of RAM. The system itself requires 400 MB of disk space in both the PC Windows/DOS and UNIX operating systems.

3.2 Software Preparation and Test Execution

The PCTides User's Manual provides specific instructions on the execution of the software. The model is run through use of a PC Windows interactive menu or a command prompt. Command prompt operation in the PC window environment is identical to UNIX operation.

The directory structure for operational use of the system is as follows:

\gems\work : working directory in which all calculations are carried out.
\gems\data : directory containing all tidal and topographical files used by GCOM.
\gems\gcom : code directory containing all executable code.
\gems\gridgen : directory containing the ASA grid generator files-PC only.
\gems\TESTAREA[1 2 3] : directory containing files for test case execution.

Note: The [1 2 3] in the TESTAREA directory denotes a choice between Test Case 1, Test Case 2 or Test Case 3. If working with Test Case 1, for example, the test directory would be \gems\TESTAREA1\ .

Execution of all activities by command prompt should be carried out in the "work" directory. These directories are transparent when using the PC Windows interactive menu. If a UNIX system is used the notation for directories must be "/" instead of "\".

3.3 Description of Test Cases

The test cases chosen for PCTides verification reflect areas of varying location, bathymetry, grid resolution, and oceanographic characteristics. The cases reflect the most common run scenarios the user will encounter, such as running without wind forcing (Test Case 1), with winds (Test Case 2), and doing nested grid runs (Test Case 3). Each test case provides instructions for running the test, examples of input files, a map of the test area and brief examples of output files by which the user may compare test results.

3.4 Input Files

Three user specified input files must be edited or copied prior to running the test cases. The files are topog.dat file, stations.dat and gcom.dat. For Test Cases 1, 2 or 3, the user will copy an existing file provided upon installation of PCTides rather than creating their own.

3.4.1 Bathymetry File (topog.dat)

For a standard PCTides run, grid generation is a required input file for creating a new bathymetry. This is accomplished by editing the gridgen.dat file for the model domain of interest and then running `~/gems/gcom/gridgen`, which reads the latitude and longitude limits and resolution stored in the "gridgen.dat" file. "Gridgen" calculates the bathymetry and topography from the global direct access files and writes the data to the file "topog.dat" in the "\gems\work" directory. However, for the purposes of these test cases an existing bathymetry is used. The user copies an existing topog.dat file using the command `cp ~ /gems/TESTAREA[1 2 3]/topog.dat`. Appendix A provides an excerpt of a topog.dat file.

3.4.2 Stations File (stations.dat)

One of the features of the model is to produce time series output of sea levels and ocean currents at specified locations. The location of these "stations" must be defined prior to model execution by setting up a "stations.dat" file. The "stations.dat" file may have up to 12 stations defined, one per line, as latitude, longitude, and name. The user is advised to have at least one output station defined for each model run. An input file for station locations may be created in stations.dat, or an existing stations.dat file may be copied using `cp ~/gems/TESTAREA[1 2 3]/stations.dat`. During the model run, time series data of sea levels, current speeds and directions are written to files with the station name and a ".tsd" extension. These files may be plotted at the end of the run for comparison with observations or tidal height predictions (".thp" files). A sample stations.dat file is shown on the following page.

Latitude (-90.0 to 90.0)	Longitude (0 to 360 E)	Station Name (max 8 characters)	Model Output Level (1 for GCOM2D)
26.17000	56.55000	Pgulf1	1
26.70000	56.28000	Pgulf2	1
24.00000	58.00000	Pgulf3	1
26.50000	53.40000	Pgulf4	1
25.67000	52.40000	Pgulf5	1
24.45000	53.37000	Pgulf6	1
27.00000	49.72000	Pgulf7	1
29.27000	50.33000	Pgulf8	1
29.83000	48.72000	Pgulf9	1

3.4.3 Parameter File (gcom.dat)

The gcom.dat file is edited, or an existing gcom.dat file is copied into the "work" directory, to select the parameter options for the model run. A typical gcom.dat file is shown below.

Line	Parameter	Typical Value
1	wind flag (0=off, 1=on)	0
2	tide flag (0=off, 1=on, 2=on + tidal data assimilation)	2
3	nesting flag (0=off, 1=on)	0
4	screen flag (0=text, 1=vectors)	0
5	inundation flag (0=off, 1=on)	0
6	output file time interval (hours, 0=none)	1.0
7	tidal start time, time zone (hh,mm,dd,mm,yyyy,hours)	00 00 23 06 1999 19.0
8	maximum model run time (hours)	48

3.5 Tidal Boundary Conditions

Tidal boundary conditions are derived from the global tide model, Finite Element Solutions, version 95.1 (FES95.1/2.1) (Shum et al., 1997). Tidal boundary conditions are derived for the model region from the global tidal files for eight constituents by determining the grid from the topography file and then writing the files:

m2.dat	2n2.dat
s2.dat	ol.dat
n2.dat	kl.dat
k2.dat	ql.dat

3.6 Wind Forcing

The winds to force the ocean model may be derived from a Navy Product wind (NOGAPS, DAMPS, or COAMPS) or MAPS field, entered manually or developed using the hurricane model. The Navy Product wind or MAPS files may be used to derive surface winds and atmospheric pressures to force the ocean model. The system looks in an external directory for the NOGAPS/COAMPS output files.

These files are interpolated to the model grid and written to the binary sequential file "atmos.dat". PCTides has been updated to use the Navy's METCAST winds. Test Case 2 incorporates COAMPS winds to provide wind forcing to the GCOM model.

3.7 Nested Model Runs

GCOM2D may be nested inside a previous run of either GCOM3D or GCOM2D. Similarly GCOM3D may be nested inside a previous run of either GCOM3D or GCOM2D. The model will look for the output file from the previous run to nest inside, so it is important to make sure the two runs (coarse and fine grids) are consecutive. Nesting may be turned "on" (flag=1) or "off" (flag=0). The sequence of events for a typical nesting run is as follows:

1. Create a bathymetry grid for the coarse model domain.
2. Generate tides for the coarse domain.
3. Generate winds for the coarse domain.
4. Set the key parameters for the coarse model run (winds=on, tides=on, nesting=off, inundation=off, output file time interval=not to infrequent in order to pass sufficient information to the nested model, i.e. no greater than one hour for tidal modeling).
5. Run GCOM2D or GCOM3D.
6. Create a bathymetry grid for the fine model domain within the coarse domain.
7. Generate winds for the fine domain.

8. Set the key parameters for the fine model run (winds=on, tides=on or on + tidal data assimilation, nesting=on, inundation=off or on).
9. Run GCOM2D or GCOM3D.
10. Display results.

3.8 Output Files

Various forms of display options are available for the PC user. The display code has been written for the PC and so there are no display options when running under UNIX. The display options may be run under the PC Windows Menu or at the command prompt.

When the user specifies stations in the menu or edits the "stations.dat" file the model produces time series output at those locations and writes to a file with the station name and an extension of ".tsd". The ".tsd" file contains the station information, date, time, tidal current speeds and tidal current direction. The output time for this file is constant, i.e., ten or twelve minutes. Tidal current speeds are in knots and the current direction is in degrees from true north, where north equals 0°. As the model runs, the tidal predictions for the IHO tidal station closest to the selected model station are also written to a file with the station name and the extension ".thp". The ".thp" file contains the same information as the ".tsd" file. However, the observation station does not have the current information and so the current speed and direction columns contain zeros. The third output file, gcom.out, is a direct access file of the full horizontal array of tidal heights and tidal current velocities. It is required as an input file for the command `~/gems/gcom/omfield`, which takes the direct access file and converts it to an ASCII file for the horizontal array.

4.0 Test Descriptions

Three test cases are provided for the purpose of verifying the installation of PCTides on the user's system. In this STD, the test cases are simply presented so that the user may verify that each executes correctly.

4.1 Test Case 1

Test Case 1 area is located on the U.S. East Coast near Chesapeake Bay, Virginia. Figure 1 provides general information about the test area with a map of the model domain marking each of the eight times series stations. Test Case 1 will be run without winds (wind flag=0).

Area: East Coast near Chesapeake Bay, VA USA

Date: July 31, 2000

Geographic Coverage:
Lon min = 74 W
Lon max = 78 W
Lat min = 35 N
Lat max = 40 N

Grid Resolution: 4.4 km (68 x 141)

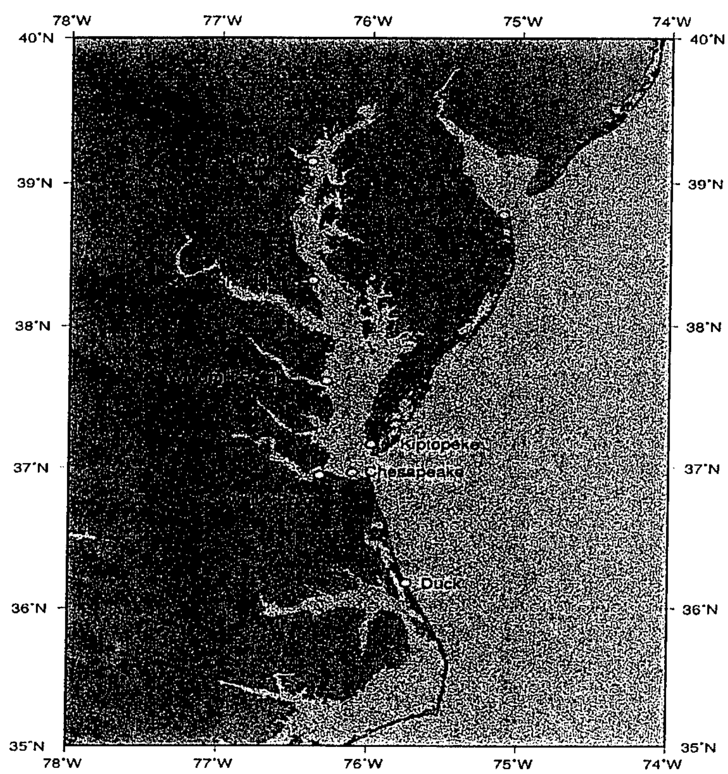

Figure 1. Test Case 1 grid information.

4.1.1 Test Case 1 Procedure

1. Copy existing topog.dat file:

`cp ~/gems/TESTAREA1/topog.dat`

into the work directory: `~/gems/work/topog.dat .`

See Appendix A for an excerpt from the topog.dat file.

2. Copy existing stations.dat file (See Figure 2):

`cp ~/gems/TESTAREA1/stations.dat`

into the work directory: `~/gems/work/stations.dat .`

36.18330	284.25339	duc	1
36.94670	283.67001	sew	1
36.96670	283.88699	che	1
37.61500	283.70999	wdm	1
37.16700	284.01199	kip	1
39.15000	283.60001	bal	1
38.32000	283.61499	sol	1
38.78000	284.88000	lew	1

Figure 2. Test Case 1 stations.dat file.

3. Copy existing gcom.dat file (See Figure 3):

`cp ~/gems/TESTAREA1/gcom.dat`

into the work directory: `~/gems/work/gcom.dat .`

```
                    0 : WIND FLAG (0=off, 1=on)
                    2 : TIDE FLAG (0=off, 1=on, 2=assimilate data)
                    0 : NESTING FLAG (0=off, 1=on)
                    0 : SCREEN FLAG (0=text, 1=vectors, 2=3Dmesh)
                    0 : INUNDATION FLAG (0=off, 1=on)
                  6.0 : OUTPUT FILE TIME INTERVAL (hours,0=none)
0 0 31 07 2000 0.0 : START TIME & TIME ZONE
                      (hh,mm,dd,mm,yyyy -tides only)
                   48 : MAXIMUM MODEL RUN TIME (hours)
```

Figure 3. Test Case 1 gcom.dat file.

Note that the wind flag should be = 0 (no winds) and the tide flag is set to assimilate data (flag=2).

4. Run the model using the following three commands:

   a. `~/gems/gcom/tides`
      Assimilates tidal data.

   b. `~/gems/gcom/gcom2d`
      Runs the PCTides GCOM2D model.

   c. `~/gems/gcom/omfield`
      Runs "omfield", which changes "gcom.out" into an ASCII file, thus producing a full horizontal array of height, speed and direction. See the User's Manual Section 4.6.1 for details on running "omfield".

4.1.2 Expected Test Results

The execution of Test Case 1 results in a "gcom.out" file, a ".tsd" file and a ".thp" file for each station. The user should compare the ".tsd" and ".thp" files to check for accuracy in the model.

4.1.3 Model Output Results

The text of the ".thp" and ".tsd" files generated by Test Case 1 is provided in Figures 4 and 5 on the following page. The tables represent the first thirty lines of output from the files generated for the Kiptopeke Station. The user's output files when compared with the examples should be identical. The example files for the remaining Test Case 1 stations are provided in Appendix B.

```
cape charles
   37.2667  283.9833     0.0     4.0
12
Tide table tidal constituents
   DATE    TIME HEIGHT   SPEED   DIREC
 20000731     0    0.43   0.00     0.0
 20000731    12    0.46   0.00     0.0
 20000731    24    0.49   0.00     0.0
 20000731    36    0.52   0.00     0.0
 20000731    48    0.53   0.00     0.0
 20000731   100    0.55   0.00     0.0
 20000731   112    0.56   0.00     0.0
 20000731   124    0.56   0.00     0.0
 20000731   136    0.56   0.00     0.0
 20000731   148    0.55   0.00     0.0
 20000731   200    0.54   0.00     0.0
 20000731   212    0.52   0.00     0.0
 20000731   224    0.50   0.00     0.0
 20000731   236    0.47   0.00     0.0
 20000731   248    0.44   0.00     0.0
 20000731   300    0.41   0.00     0.0
 20000731   312    0.37   0.00     0.0
 20000731   324    0.33   0.00     0.0
 20000731   336    0.28   0.00     0.0
 20000731   348    0.24   0.00     0.0
 20000731   400    0.19   0.00     0.0
 20000731   412    0.14   0.00     0.0
 20000731   424    0.09   0.00     0.0
 20000731   436    0.03   0.00     0.0
 20000731   448   -0.02   0.00     0.0
 20000731   500   -0.07   0.00     0.0
 20000731   512   -0.12   0.00     0.0
 20000731   524   -0.17   0.00     0.0
 20000731   536   -0.22   0.00     0.0
 20000731   548   -0.26   0.00     0.0
```

Figure 4. Excerpt from "kip.thp" file for Test Case 1. Station is Cape Charles, Virginia, USA.

```
kip
   37.1670  284.0120     0.0     2.9
12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME   HEIGHT SPEED DIREC
 20000731     0   0.615  0.520 321.1
 20000731    12   0.641  0.515 322.0
 20000731    24   0.661  0.508 322.8
 20000731    36   0.675  0.498 323.7
 20000731    48   0.684  0.486 324.7
 20000731   100   0.687  0.470 325.9
 20000731   112   0.683  0.452 327.3
 20000731   124   0.674  0.431 328.9
 20000731   136   0.658  0.407 330.8
 20000731   148   0.636  0.380 333.2
 20000731   200   0.608  0.351 336.2
 20000731   212   0.573  0.318 340.0
 20000731   224   0.533  0.284 344.9
 20000731   236   0.488  0.250 351.8
 20000731   248   0.438  0.216   1.7
 20000731   300   0.384  0.188  15.9
 20000731   312   0.325  0.172  35.0
 20000731   324   0.263  0.174  56.7
 20000731   336   0.200  0.193  76.2
 20000731   348   0.137  0.223  91.6
 20000731   400   0.075  0.257 103.1
 20000731   412   0.014  0.291 111.8
 20000731   424  -0.047  0.322 118.4
 20000731   436  -0.105  0.350 123.6
 20000731   448  -0.161  0.374 127.5
 20000731   500  -0.215  0.394 130.6
 20000731   512  -0.267  0.412 132.9
 20000731   524  -0.316  0.425 134.6
 20000731   536  -0.364  0.436 136.0
 20000731   548  -0.408  0.443 137.2
```

Figure 5. Excerpt from "kip.tsd" file for Test Case 1. Station is Kiptopeke, Virginia, USA.

4.1.4 Assumptions and Constraints

The successful replication of the preceding PCTides results is dependent on the application of identical input data files. It is essential, therefore, that the appropriate files be correctly installed and available to the models.

4.2 Test Case 2

Test Case 2 is located in Puget Sound near Seattle, Washington. Figure 6 provides general information about the test area with a map of the model domain marking the two times series stations. Test Case 2 will be run with winds (wind flag=1).

Area: Puget Sound, Washington, USA

Date: February 8, 2002

Geographic Coverage:
Lon min = 122 W
Lon max = 126 W
Lat min = 47 N
Lat max = 51 N

Grid Resolution: 2.1 km
(132 x 182)

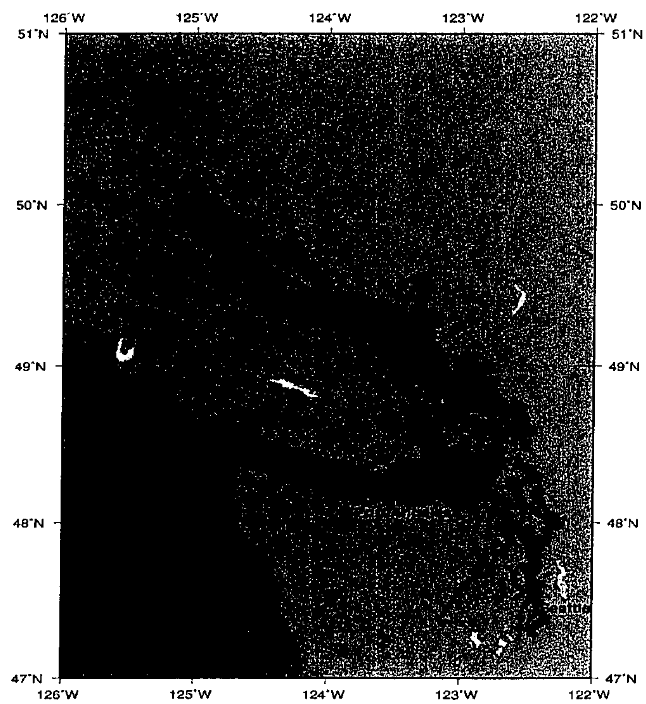

Figure 6. Test Case 2 grid information.

4.2.1 Test Case 2 Test Procedure

1. Copy existing topog.dat file to the work directory:

```
cp          ~/gems/TESTAREA2/topog.dat

to:         ~/gems/work/topog.dat .
```

See Appendix A for an excerpt from a sample topog.dat file.

2. Copy existing stations.dat file (Figure 7) into the work directory:

cp ~/gems/TESTAREA2/stations.dat

to: ~/gems/work/stations.dat .

48.18500	236.57001	ang	1
47.55000	237.59001	sea	1

Figure 7. Test Case 2 stations.dat file.

3. Copy existing gcom.dat file (See Figure 8) into the work directory:

cp ~gems/TESTAREA2/gcom.dat

to: ~gems/work/gcom.dat .

```
                    1 : WIND FLAG (0=off, 1=on)
                    2 : TIDE FLAG (0=off, 1=on, 2=assimilate data)
                    0 : NESTING FLAG (0=off, 1=on)
                    0 : SCREEN FLAG (0=text, 1=vectors, 2=3Dmesh)
                    0 : INUNDATION FLAG (0=off, 1=on)
                  6.0 : OUTPUT FILE TIME INTERVAL (hours,0=none)
 0 0 31 07 2000 0.0 : START TIME & TIME ZONE
                      (hh,mm,dd,mm,yyyy -tides only)
                   48 : MAXIMUM MODEL RUN TIME (hours)
```

Figure 8. Test Case 2 gcom.dat file.

Note that for Test Case 2 the wind flag is "on" (flag=1).

4. Prepare COAMPS Eastern Pacific wind forcing to use in the tide model. The following commands will take IEEE COAMPS E_PAC fields and write them into an ASCII file called atmos.dat. For this test, copy the atmos.dat file into the work directory:

cp ~/gems/TESTAREA2/atmos.dat

to: ~/gems/work/atmos.dat.

For Naval Oceanographic Office users, the code required to pull in the COAMPS fields for the atmos.dat file has been automated at NAVOCEANO.

5. Run the model using the following commands:

a. ~/gems/gcom/tides
   Assimilate tidal data.

b. `~/gems/gcom/gcom2d`

Runs the PCTides GCOM2D model.

c. `~/gems/gcom/omfield`

Runs "omfield", which changes "gcom.out" into an ASCII file, thus producing a full horizontal array of height, speed and direction. See the User's Manual Section 4.6.1 for details on running "omfield".

4.2.2 Expected Test Results

The execution of Test Case 2 results in a "gcom.out" file, a ".tsd" file and a ".thp" file for both stations. The user should compare the ".tsd" files with the ".thp" files to check for accuracy in the model.

4.2.3 Model Output Results

The first thirty lines of output from the ".thp" and ".tsd" files generated by Test Case 2 is provided for the Seattle station in Figures 9 and 10. The user's output files when compared with the examples should be identical. The example output for the Port Angeles station is listed in Appendix B, Figures B-15 and B-16.

```
seattle
   47.6000  237.6667    0.0     0.0
12
Tide table tidal constituents
   DATE    TIME HEIGHT  SPEED  DIREC
 20020208    0  -0.37   0.00    0.0
 20020208   12  -0.51   0.00    0.0
 20020208   24  -0.65   0.00    0.0
 20020208   36  -0.80   0.00    0.0
 20020208   48  -0.94   0.00    0.0
 20020208  100  -1.08   0.00    0.0
 20020208  112  -1.22   0.00    0.0
 20020208  124  -1.35   0.00    0.0
 20020208  136  -1.48   0.00    0.0
 20020208  148  -1.60   0.00    0.0
 20020208  200  -1.72   0.00    0.0
 20020208  212  -1.82   0.00    0.0
 20020208  224  -1.92   0.00    0.0
 20020208  236  -2.00   0.00    0.0
 20020208  248  -2.07   0.00    0.0
 20020208  300  -2.13   0.00    0.0
 20020208  312  -2.18   0.00    0.0
 20020208  324  -2.21   0.00    0.0
 20020208  336  -2.23   0.00    0.0
 20020208  348  -2.23   0.00    0.0
 20020208  400  -2.23   0.00    0.0
 20020208  412  -2.20   0.00    0.0
 20020208  424  -2.17   0.00    0.0
 20020208  436  -2.12   0.00    0.0
 20020208  448  -2.06   0.00    0.0
 20020208  500  -1.98   0.00    0.0
 20020208  512  -1.90   0.00    0.0
 20020208  524  -1.80   0.00    0.0
 20020208  536  -1.70   0.00    0.0
 20020208  548  -1.58   0.00    0.0
```

Figure 9. Excerpt from the Seattle station "sea.thp" output file for Test Case 2.

```
sea
   47.5500  237.5900    0.0    70.9
12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME  HEIGHT SPEED DIREC
 20020208     0 -0.519  0.183    0.1
 20020208    12 -0.635  0.192    2.3
 20020208    24 -0.751  0.195    4.0
 20020208    36 -0.868  0.198    6.0
 20020208    48 -0.981  0.202    7.9
 20020208   100 -1.090  0.203    9.8
 20020208   112 -1.191  0.203   12.0
 20020208   124 -1.286  0.202   14.3
 20020208   136 -1.377  0.198   16.7
 20020208   148 -1.466  0.192   19.2
 20020208   200 -1.547  0.186   22.0
 20020208   212 -1.618  0.178   25.1
 20020208   224 -1.680  0.170   28.5
 20020208   236 -1.731  0.162   32.2
 20020208   248 -1.774  0.152   36.5
 20020208   300 -1.805  0.141   41.9
 20020208   312 -1.826  0.130   48.5
 20020208   324 -1.840  0.119   56.9
 20020208   336 -1.840  0.114   63.9
 20020208   348 -1.830  0.107   72.6
 20020208   400 -1.812  0.103   83.6
 20020208   412 -1.779  0.103   94.4
 20020208   424 -1.734  0.105  105.5
 20020208   436 -1.681  0.112  116.4
 20020208   448 -1.615  0.120  124.9
 20020208   500 -1.545  0.130  132.6
 20020208   512 -1.466  0.142  139.2
 20020208   524 -1.378  0.153  144.6
 20020208   536 -1.279  0.165  148.6
 20020208   548 -1.174  0.176  152.3
```

Figure 10. Excerpt from the Seattle station "sea.tsd" output file for Test Case 2.

4.2.4 Assumptions and Constraints

The successful replication of the PCTides results shown above is, obviously, dependent on the application of identical input data files. It is essential, therefore, that the appropriate files be correctly installed and available to the models.

4.3 Test Case 3

Test Case 3 demonstrates a nested model scenario. It includes instructions and output for both the coarse and finer resolution model runs. The geographic location for Test Case 3 coarse run is the coastline of the United Kingdom including ten stations. The location for the nested case is along the Bristol Channel with one station near Ilfracombe, England. Figures 11 and 12 provide general information and maps for the coarse test area and the finer resolution nest region, respectively.

Area: Coastline of United Kingdom

Date: July 31, 2000

Geographic Coverage:
Lon min = 7.0 E
Lon max = 12.0 W
Lat min = 46.0 N
Lat max = 65.0 N

Grid Resolution: 9.5 km
(154 x 227)

Figure 11. Test Case 3 coarse area grid information.

Area: Bristol Channel in United Kingdom.

Date: July 31, 2000

Geographic Coverage:
Lon min = 2.0 W
Lon max = 8.0 W
Lat min = 50.6 N
Lat max = 52.4 N

Grid Resolution: 3.1 km (138 x 70)

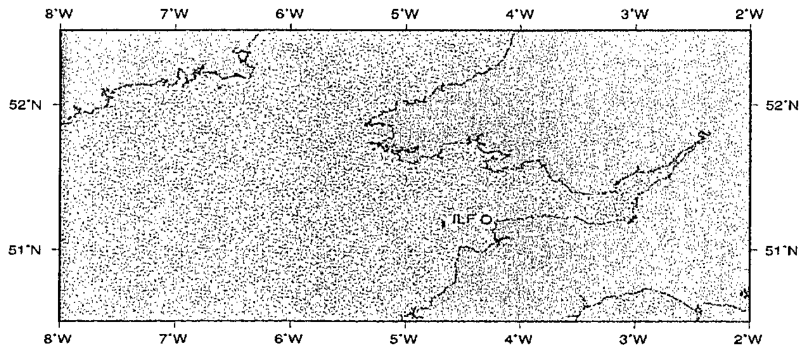

Figure 12. Test Case 3 nested area grid information.

4.3.1 Test Case 3 Test Procedure

Coarse Model Run

1. Copy existing topog.dat file into the work directory:

```
cp          ~/gems/TESTAREA3/topog_coarse.dat
```

```
to:         ~/gems/work/topog.dat .
```

See Appendix A for an excerpt from a sample topog.dat file.

2. Copy existing stations.dat file (See Figure 13):

```
cp          ~/gems/TESTAREA3/stations.dat
```

```
to:         ~/gems/work/stations.dat .
```

57.14500	357.92020	abe	1
51.21000	355.70001	ilf	1
51.04000	1.30000	dov	1
54.03000	356.60001	hey	1
53.63000	359.91010	imm	1
60.16000	358.75000	ler	1
53.50000	356.65021	liv	1
50.65000	0.05000	new	1
51.45000	0.72000	she	1
58.21000	353.66000	sto	1

Figure 13. Test Case 3 stations.dat file.

3. Copy gcom.dat file (See Figure 14) into the work directory:

```
cp      ~gems/TESTAREA3/gcom_coarse.dat

to:     ~gems/work/gcom.dat .
```

Note that the Nesting Flag should be "off" (flag=0) for the coarse run. Test Case 3 is being run without winds; so the wind flag is also "off" (flag=0). The tide flag is set to assimilate data (flag=2).

```
                    0 : WIND FLAG (0=off, 1=on)
                    2 : TIDE FLAG (0=off, 1=on, 2=assimilate data)
                    0 : NESTING FLAG (0=off, 1=on)
                    0 : SCREEN FLAG (0=text, 1=vectors, 2=3Dmesh)
                    0 : INUNDATION FLAG (0=off, 1=on)
                  1.0 : OUTPUT FILE TIME INTERVAL (hours,0=none)
 0 0 31 07 2000 0.0 : START TIME & TIME ZONE
                        (hh,mm,dd,mm,yyyy -tides only)
                   48 : MAXIMUM MODEL RUN TIME (hours)
```

Figure 14. Test Case 3 coarse run gcom.dat file.

4. Run the model using the following commands:

   a. `~/gems/gcom/tides`
      Assimilates tidal data.

   b. `~/gems/gcom/gcom2d`
      Runs the PCTides GCOM2D model.

The execution of this initial run of Test Case 3 results in a "gcom.out" file, a ".tsd" file and a ".thp" file for each station.

5. Save out the coarse run .tsd and .thp files under a new name, as seen in the example below using a "_c" after the station name. This allows for the finer resolution run to output new .tsd and .thp files and not overwrite the coarse run's files.

```
mv abe.tsd abe_c.tsd
mv ilf.tsd ilf_c.tsd
mv dov.tsd dov_c.tsd
mv hey.tsd hey_c.tsd
mv imm.tsd imm_c.tsd
mv ler.tsd ler_c.tsd
mv liv.tsd liv_c.tsd
mv new.tsd new_c.tsd
mv she.tsd she_c.tsd
mv sto.tsd sto_c.tsd
mv abe.thp abe_c.thp
mv ilf.thp ilf_c.thp
mv dov.thp dov_c.thp
mv hey.thp hey_c.thp
mv imm.thp imm_c.thp
mv ler.thp ler_c.thp
mv liv.thp liv_c.thp
mv new.thp new_c.thp
mv she.thp she_c.thp
mv sto.thp sto_c.thp
```

Nested Run

1. Copy the existing nested grid topography to the work directory:

cp ~/gems/TESTAREA3/topog.dat

to: ~/gems/work/topog.dat.

2. Copy the gcom.dat for the fine resolution run (See Figure 15):

cp ~/gems/TESTAREA3/gcom.dat

to: ~/gems/work/gcom.dat.

Make sure that the nesting flag is turned "on" (flag=1), the tide flag is turned "off" (flag=0), and the wind flag is turned "off" (flag=0).

```
                  0 : WIND FLAG (0=off, 1=on)
                  0 : TIDE FLAG (0=off, 1=on, 2=assimilate data)
                  1 : NESTING FLAG (0=off, 1=on)
                  0 : SCREEN FLAG (0=text, 1=vectors, 2=3Dmesh)
                  0 : INUNDATION FLAG (0=off, 1=on)
                1.0 : OUTPUT FILE TIME INTERVAL (hours,0=none)
0 0 31 07 2000  0.0 : START TIME & TIME ZONE
                      (hh,mm,dd,mm,yyyy -tides only)
                 48 : MAXIMUM MODEL RUN TIME (hours)
```

Figure 15. Test Case 3 nested run gcom.dat file.

3. Run the model using the following commands:

   a. ~/gems/gcom/gcom2d
      Run the PCTides GCOM2D model.

   b. ~/gems/gcom/omfield
      Runs "omfield". See the User's Manual Section 4.6.1 for details on running "omfield".

4.3.2 Expected Test Results

The execution of Test Case 3 results in a "gcom.out" file and a ".tsd" file for each station, for both the coarse and the finer resolution grids. The ".thp" files are also generated during both the coarse and high resolution runs.

4.3.3 Model Output Results

The following tables represent the first thirty lines of output from the nested run files generated for the Ilfracombe station. The output from the ".thp" file (Figure 16) provides the tide information for comparison with the ".tsd" files from the nested case. The output from the ".tsd" file generated by the nested run is shown in Figure 17. Results from the remaining nine stations of the coarse run are available in Appendix B, Figures B-17 through B-34. The user's output files when compared with the examples should be identical.

```
ilfracombe
   51.2167  355.8833     0.0     0.0
10
Tide table tidal constituents
   DATE    TIME HEIGHT  SPEED  DIREC
 20000731   10   -3.82   0.00    0.0
 20000731   20   -3.70   0.00    0.0
 20000731   30   -3.55   0.00    0.0
 20000731   40   -3.37   0.00    0.0
 20000731   50   -3.17   0.00    0.0
 20000731  100   -2.94   0.00    0.0
 20000731  110   -2.69   0.00    0.0
 20000731  120   -2.43   0.00    0.0
 20000731  130   -2.14   0.00    0.0
 20000731  140   -1.83   0.00    0.0
 20000731  150   -1.51   0.00    0.0
 20000731  200   -1.18   0.00    0.0
 20000731  210   -0.83   0.00    0.0
 20000731  220   -0.48   0.00    0.0
 20000731  230   -0.12   0.00    0.0
 20000731  240    0.25   0.00    0.0
 20000731  250    0.62   0.00    0.0
 20000731  300    0.99   0.00    0.0
 20000731  310    1.35   0.00    0.0
 20000731  320    1.71   0.00    0.0
 20000731  330    2.05   0.00    0.0
 20000731  340    2.39   0.00    0.0
 20000731  350    2.71   0.00    0.0
 20000731  400    3.01   0.00    0.0
 20000731  410    3.30   0.00    0.0
 20000731  420    3.56   0.00    0.0
 20000731  430    3.79   0.00    0.0
 20000731  440    4.00   0.00    0.0
 20000731  450    4.19   0.00    0.0
 20000731  500    4.34   0.00    0.0
```

Figure 16. Excerpt from the Ilfracombe station "ilf.thp" output file for Test Case 3.

```
ilf
   51.2100  355.7000     0.0    22.9
10
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME  HEIGHT SPEED DIREC
 20000731   10 -3.522  0.273   45.2
 20000731   20 -3.412  0.493   69.6
 20000731   30 -3.037  0.532   74.9
 20000731   40 -2.768  0.400   82.9
 20000731   50 -2.376  0.188  130.9
 20000731  100 -2.302  0.102  144.3
 20000731  110 -2.347  0.101   39.3
 20000731  120 -2.540  0.182   60.0
 20000731  130 -2.254  0.259   72.1
 20000731  140 -1.811  0.409   77.3
 20000731  150 -1.384  0.546   72.0
 20000731  200 -1.142  0.587   68.7
 20000731  210 -0.989  0.604   66.3
 20000731  220 -0.773  0.705   69.3
 20000731  230 -0.491  0.762   69.1
 20000731  240 -0.185  0.789   68.3
 20000731  250  0.088  0.790   65.5
 20000731  300  0.335  0.795   65.4
 20000731  310  0.636  0.833   67.0
 20000731  320  0.944  0.873   67.1
 20000731  330  1.251  0.910   66.4
 20000731  340  1.500  0.917   65.1
 20000731  350  1.668  0.891   64.2
 20000731  400  1.872  0.860   65.0
 20000731  410  2.187  0.860   66.4
 20000731  420  2.499  0.864   65.5
 20000731  430  2.657  0.821   63.5
 20000731  440  2.732  0.753   63.0
 20000731  450  2.864  0.707   64.0
 20000731  500  3.068  0.689   65.0
```

Figure 17. Excerpt from the Ilfracombe station "ilf.tsd" output file for Test Case 3 nest case.

It is expected that the higher resolution (nested) case results will compare better to observations than the coarser model results.

4.3.4 Assumptions and Constraints

The successful replication of the PCTides results shown above is, obviously, dependent on the application of identical input data files. It is essential, therefore, that the appropriate files be correctly installed and available to the models.

5.0 Acronyms and Abbreviations

ASA	Applied Sciences Associates
ASCII	American Standard Code for Information Interchange
COAMPS	Coupled Oceanographic and Atmospheric Mesoscale Prediction System
CPU	Central Processing Unit
DAMPS	Distributed Atmospheric Mesoscale Prediction System
DOS	Disk Operating System
E_PAC	Eastern Pacific
FES	Finite Element Solution
GCOM2D	Coastal Ocean Model 2-D
GCOM3D	Coastal Ocean Model 3-D
GEMS	Global Environmental Modeling Services
IEEE	Institute of Electrical and Electronic Engineers
IHO	International Hydrographic Office
MAPS	Mesoscale Atmospheric Prediction System
MB	Megabyte
NAVOCEANO	Naval Oceanographic Office
NOGAPS	Navy Operational Global Atmospheric Prediction System
NRL	Naval Research Laboratory
OAML	Oceanographic and Atmospheric Master Library
PC	Personal Computer
PCTides	Globally Relocatable Navy Tide/Atmosphere Modeling System
RAM	Random Access Memory
R & D	Research and Development
SDD	Software Design Document
SRS	Software Requirements Specification
STD	Software Test Description
UNIX	Workstation Operating System

Appendix A

Topog.dat File Example

```
CHESAP2
68 141 3 40.000 284.000 10.000 36.0000 40.2175 141.0000 4.4000
141
348.98  377.48  433.16  478.79  469.68  399.27  311.10  250.65
217.33  192.43  171.27  155.17  144.16  136.81  131.39  126.89
122.72  120.55  123.17  128.60  134.83  143.98  154.21  163.72
176.47  192.82  205.84  206.87  195.23  180.60  169.20  162.28
166.13  182.23  195.14  187.74  164.01  141.31  125.01  109.25
 93.28   82.47   80.87   84.39   84.04   79.33   78.20   85.23
 97.01  104.35  101.71   93.15   84.86   78.60   72.40   62.87
 49.26   35.77   27.06   24.36   26.18   29.88   34.73   41.96
 49.83   53.31   51.06   46.92
140
336.85  366.91  393.64  393.40  352.60  289.02  233.93  203.22
188.98  178.94  169.38  160.75  154.32  149.97  146.00  142.52
141.46  142.91  142.04  134.75  128.78  134.31  146.04  154.12
159.69  166.51  171.56  169.50  160.51  150.12  142.86  140.55
145.23  158.19  175.51  186.59  184.01  173.06  160.51  144.24
122.71  100.85   85.10   77.58   75.14   75.68   79.82   86.58
 92.90   95.47   93.25   88.15   81.67   73.25   62.56   51.13
 40.07   29.57   21.66   19.28   22.24   27.65   34.73   44.05
 52.32   54.44   50.08   42.84
139
332.79 354.83 350.55 313.50 261.95 219.46 196.19 189.11
189.30 189.10 185.70 180.47 176.88 174.22 168.91 164.14
163.81 163.44 155.74 139.49 125.81 127.01 137.27 143.14
143.72 144.70 145.47 142.56 136.25 129.44 125.40 126.26
132.25 144.50 164.15 184.81 195.05 191.94 181.09 165.55
144.49 118.78  93.90  76.71  69.67  70.81  75.78  80.52
 83.74  85.38  85.35  82.98  77.00  66.76  53.33  40.23
 30.00  22.08  17.12  17.18  21.58  27.51  34.46  43.07
 50.29  51.48  46.49  38.72
138
343.20  340.52  306.87  254.70  214.95  199.15  201.57  213.25
224.38  228.16  224.45  217.55  212.29  206.13  194.78  185.62
182.80  177.06  162.74  143.27  127.37  123.76  128.54  130.95
130.01  130.32  130.66  127.80  122.53  117.75  116.42  120.26
129.39  144.97  166.98  189.10  201.57  199.48  186.87  171.42
154.67  132.85  107.16   85.31   73.32   70.70   71.95   72.86
 74.32   77.40   79.68   77.20   68.71   56.30   42.25   29.47
 20.66   16.02   15.45   18.92   24.67   30.20   34.97   40.42
 45.42   45.94   41.35   34.73
137
359.70  318.70  268.05  225.06  207.96  215.69  239.98  268.82
285.13  282.17  268.31  252.92  238.87  222.60  203.30  189.57
183.40  175.59  161.85  145.52  132.19  126.10  124.86  123.52
122.75  124.50  125.10  121.04  114.97  111.56  113.12  119.67
131.81  151.48  176.03  196.96  206.36  200.56  183.32  165.26
152.10  138.50  119.58  100.21   87.87   83.21   80.59   76.33
 73.14   73.92   74.53   68.30   55.62   41.81   29.48   19.99
 14.89   13.99   16.51   21.82   28.28   33.15   35.51   38.05
 41.30   41.27   36.96   31.45
136
343.44  283.49  237.90  217.88  227.80  263.14  310.54  347.12
351.22  325.25  291.18  262.63  237.99  212.90  189.77  174.42
166.83  161.57  154.09  144.86  138.01  134.47  131.21  126.05
120.87  119.14  118.74  115.29  110.82  109.98  114.08  122.29
135.46  155.50  179.32  198.27  204.18  193.97  172.62  152.21
141.14  135.02  125.29  112.66  103.85   99.84   95.22   86.49
 76.70   70.11   64.10   53.08   38.78   27.08   19.33   14.58
 12.86   13.87   17.03   22.29   28.54   32.68   33.76   35.36
 38.46   38.71   34.57   28.94
```

Appendix B

Test Case 1 Model Output Data

The following figures represent the first thirty lines of code from the ".thp" and ".tsd" files generated by the PCTides test run without winds, Test Case 1.

Station 1: Duck

```
portsmouth_elizabeth river
   36.6667  283.7000    0.0     0.0
12
Tide table tidal constituents
   DATE    TIME HEIGHT  SPEED   DIREC
 20000731    0    0.37   0.00    0.0
 20000731   12    0.42   0.00    0.0
 20000731   24    0.46   0.00    0.0
 20000731   36    0.50   0.00    0.0
 20000731   48    0.53   0.00    0.0
 20000731  100    0.56   0.00    0.0
 20000731  112    0.58   0.00    0.0
 20000731  124    0.60   0.00    0.0
 20000731  136    0.61   0.00    0.0
 20000731  148    0.62   0.00    0.0
 20000731  200    0.62   0.00    0.0
 20000731  212    0.62   0.00    0.0
 20000731  224    0.60   0.00    0.0
 20000731  236    0.59   0.00    0.0
 20000731  248    0.57   0.00    0.0
 20000731  300    0.54   0.00    0.0
 20000731  312    0.51   0.00    0.0
 20000731  324    0.47   0.00    0.0
 20000731  336    0.43   0.00    0.0
 20000731  348    0.39   0.00    0.0
 20000731  400    0.34   0.00    0.0
 20000731  412    0.29   0.00    0.0
 20000731  424    0.23   0.00    0.0
 20000731  436    0.18   0.00    0.0
 20000731  448    0.12   0.00    0.0
 20000731  500    0.06   0.00    0.0
 20000731  512    0.00   0.00    0.0
 20000731  524   -0.05   0.00    0.0
 20000731  536   -0.11   0.00    0.0
 20000731  548   -0.17   0.00    0.0
```

Figure B-1. Excerpt from "duc.thp" file for Test Case 1. Station is Portsmouth-Elizabeth River, NC, USA.

```
duc
   36.1833  284.2534     0.0     8.9
12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME   HEIGHT SPEED DIREC
 20000731    0   0.896  0.177 274.7
 20000731   12   0.890  0.158 276.8
 20000731   24   0.877  0.137 279.8
 20000731   36   0.856  0.116 284.1
 20000731   48   0.828  0.095 290.5
 20000731  100   0.793  0.075 300.9
 20000731  112   0.752  0.059 318.4
 20000731  124   0.705  0.051 345.8
 20000731  136   0.652  0.056  15.9
 20000731  148   0.594  0.074  37.2
 20000731  200   0.531  0.098  50.0
 20000731  212   0.463  0.125  58.0
 20000731  224   0.390  0.152  63.4
 20000731  236   0.313  0.178  67.3
 20000731  248   0.231  0.202  70.4
 20000731  300   0.147  0.223  72.9
 20000731  312   0.061  0.241  74.9
 20000731  324  -0.026  0.255  76.6
 20000731  336  -0.110  0.266  78.1
 20000731  348  -0.192  0.274  79.3
 20000731  400  -0.270  0.280  80.3
 20000731  412  -0.343  0.283  81.1
 20000731  424  -0.412  0.284  81.7
 20000731  436  -0.475  0.283  82.2
 20000731  448  -0.533  0.279  82.6
 20000731  500  -0.584  0.274  83.1
 20000731  512  -0.629  0.265  83.6
 20000731  524  -0.667  0.255  84.0
 20000731  536  -0.698  0.244  84.5
 20000731  548  -0.722  0.230  84.9
```

Figure B-2. Excerpt from "duc.tsd" file for Test Case 1. Station is Duck, NC, USA.

Station 2: Sewell's Point

```
old point comfort
   37.0000  283.7000    0.0    4.7
12
Tide table tidal constituents
   DATE    TIME HEIGHT  SPEED  DIREC
 20000731    0   0.46   0.00    0.0
 20000731   12   0.49   0.00    0.0
 20000731   24   0.52   0.00    0.0
 20000731   36   0.54   0.00    0.0
 20000731   48   0.55   0.00    0.0
 20000731  100   0.56   0.00    0.0
 20000731  112   0.56   0.00    0.0
 20000731  124   0.56   0.00    0.0
 20000731  136   0.56   0.00    0.0
 20000731  148   0.55   0.00    0.0
 20000731  200   0.53   0.00    0.0
 20000731  212   0.51   0.00    0.0
 20000731  224   0.48   0.00    0.0
 20000731  236   0.45   0.00    0.0
 20000731  248   0.42   0.00    0.0
 20000731  300   0.38   0.00    0.0
 20000731  312   0.34   0.00    0.0
 20000731  324   0.29   0.00    0.0
 20000731  336   0.25   0.00    0.0
 20000731  348   0.20   0.00    0.0
 20000731  400   0.14   0.00    0.0
 20000731  412   0.09   0.00    0.0
 20000731  424   0.04   0.00    0.0
 20000731  436  -0.01   0.00    0.0
 20000731  448  -0.07   0.00    0.0
 20000731  500  -0.12   0.00    0.0
 20000731  512  -0.17   0.00    0.0
 20000731  524  -0.22   0.00    0.0
 20000731  536  -0.26   0.00    0.0
 20000731  548  -0.30   0.00    0.0
```

Figure B-3. Excerpt from "sew.thp" file for Test Case 1. Station Old Point Comfort, VA, USA.

```
sew
   36.9467  283.6700    0.0     3.5
12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME   HEIGHT SPEED DIREC
 20000731    0   0.408  0.172 307.5
 20000731   12   0.438  0.172 307.5
 20000731   24   0.463  0.172 307.5
 20000731   36   0.484  0.170 307.3
 20000731   48   0.499  0.166 306.7
 20000731  100   0.509  0.161 305.4
 20000731  112   0.515  0.156 303.7
 20000731  124   0.516  0.152 301.7
 20000731  136   0.512  0.147 299.0
 20000731  148   0.504  0.142 295.7
 20000731  200   0.491  0.136 292.1
 20000731  212   0.473  0.131 288.3
 20000731  224   0.451  0.125 283.7
 20000731  236   0.425  0.119 278.4
 20000731  248   0.395  0.112 272.4
 20000731  300   0.362  0.106 266.0
 20000731  312   0.326  0.100 258.7
 20000731  324   0.288  0.093 249.9
 20000731  336   0.247  0.087 239.3
 20000731  348   0.206  0.082 226.6
 20000731  400   0.164  0.077 211.6
 20000731  412   0.121  0.075 194.1
 20000731  424   0.076  0.079 175.8
 20000731  436   0.030  0.088 159.8
 20000731  448  -0.018  0.101 148.2
 20000731  500  -0.067  0.115 140.8
 20000731  512  -0.115  0.128 136.7
 20000731  524  -0.163  0.139 134.7
 20000731  536  -0.208  0.147 134.0
 20000731  548  -0.251  0.153 134.2
```

Figure B-4. Excerpt from "sew.tsd" file for Test Case 1. Station is Sewell's Point, VA, USA.

Station 3: Chesapeake

```
virginia beach
   36.8333  284.0333     0.0     6.1
12
Tide table tidal constituents
   DATE    TIME HEIGHT   SPEED   DIREC
 20000731     0    0.77   0.00    0.0
 20000731    12    0.77   0.00    0.0
 20000731    24    0.77   0.00    0.0
 20000731    36    0.75   0.00    0.0
 20000731    48    0.73   0.00    0.0
 20000731   100    0.70   0.00    0.0
 20000731   112    0.67   0.00    0.0
 20000731   124    0.63   0.00    0.0
 20000731   136    0.58   0.00    0.0
 20000731   148    0.53   0.00    0.0
 20000731   200    0.48   0.00    0.0
 20000731   212    0.42   0.00    0.0
 20000731   224    0.36   0.00    0.0
 20000731   236    0.29   0.00    0.0
 20000731   248    0.22   0.00    0.0
 20000731   300    0.15   0.00    0.0
 20000731   312    0.08   0.00    0.0
 20000731   324    0.01   0.00    0.0
 20000731   336   -0.06   0.00    0.0
 20000731   348   -0.13   0.00    0.0
 20000731   400   -0.19   0.00    0.0
 20000731   412   -0.26   0.00    0.0
 20000731   424   -0.32   0.00    0.0
 20000731   436   -0.38   0.00    0.0
 20000731   448   -0.43   0.00    0.0
 20000731   500   -0.48   0.00    0.0
 20000731   512   -0.52   0.00    0.0
 20000731   524   -0.56   0.00    0.0
 20000731   536   -0.59   0.00    0.0
 20000731   548   -0.61   0.00    0.0
```

Figure B-5. Excerpt from "che.thp" file for Test Case 1. Station is Virginia Beach, VA, USA.

```
che
   36.9667  283.8870     0.0     7.7
12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME   HEIGHT SPEED DIREC
 20000731     0   0.569  0.516 269.4
 20000731    12   0.593  0.509 268.4
 20000731    24   0.611  0.500 267.5
 20000731    36   0.624  0.488 266.4
 20000731    48   0.631  0.473 265.3
 20000731   100   0.634  0.456 264.1
 20000731   112   0.631  0.436 262.8
 20000731   124   0.623  0.414 261.2
 20000731   136   0.609  0.389 259.6
 20000731   148   0.589  0.362 257.8
 20000731   200   0.564  0.332 255.6
 20000731   212   0.533  0.300 253.1
 20000731   224   0.496  0.266 249.9
 20000731   236   0.454  0.231 245.7
 20000731   248   0.408  0.194 239.6
 20000731   300   0.358  0.158 230.3
 20000731   312   0.305  0.126 215.4
 20000731   324   0.247  0.106 191.6
 20000731   336   0.187  0.108 162.5
 20000731   348   0.125  0.133 139.5
 20000731   400   0.064  0.169 125.3
 20000731   412   0.005  0.209 116.6
 20000731   424  -0.051  0.248 110.9
 20000731   436  -0.104  0.286 106.8
 20000731   448  -0.154  0.320 103.6
 20000731   500  -0.202  0.350 101.1
 20000731   512  -0.248  0.375  99.0
 20000731   524  -0.293  0.395  97.1
 20000731   536  -0.336  0.410  95.5
 20000731   548  -0.375  0.421  93.8
```

Figure B-6. Excerpt from "che.tsd" file for Test Case 1. Station is Chesapeake, VA, USA.

Station 4: Windmill Point

```
stingray point light
   37.5667  283.7333     0.0     6.5
12
Tide table tidal constituents
   DATE     TIME HEIGHT  SPEED   DIREC
 20000731     0   0.05   0.00     0.0
 20000731    12   0.07   0.00     0.0
 20000731    24   0.09   0.00     0.0
 20000731    36   0.11   0.00     0.0
 20000731    48   0.13   0.00     0.0
 20000731   100   0.15   0.00     0.0
 20000731   112   0.17   0.00     0.0
 20000731   124   0.19   0.00     0.0
 20000731   136   0.20   0.00     0.0
 20000731   148   0.21   0.00     0.0
 20000731   200   0.22   0.00     0.0
 20000731   212   0.23   0.00     0.0
 20000731   224   0.24   0.00     0.0
 20000731   236   0.24   0.00     0.0
 20000731   248   0.24   0.00     0.0
 20000731   300   0.24   0.00     0.0
 20000731   312   0.24   0.00     0.0
 20000731   324   0.24   0.00     0.0
 20000731   336   0.23   0.00     0.0
 20000731   348   0.22   0.00     0.0
 20000731   400   0.21   0.00     0.0
 20000731   412   0.19   0.00     0.0
 20000731   424   0.18   0.00     0.0
 20000731   436   0.16   0.00     0.0
 20000731   448   0.14   0.00     0.0
 20000731   500   0.12   0.00     0.0
 20000731   512   0.10   0.00     0.0
 20000731   524   0.08   0.00     0.0
 20000731   536   0.06   0.00     0.0
 20000731   548   0.04   0.00     0.0
```

Figure B-7. Excerpt from "wdm.thp" file for Test Case 1. Station is Stingray Point Light, VA, USA.

```
wdm
   37.6150  283.7100     0.0     6.4
12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME  HEIGHT SPEED DIREC
 20000731     0  0.011  0.160 357.3
 20000731    12  0.038  0.178   2.2
 20000731    24  0.060  0.192   6.7
 20000731    36  0.077  0.206  10.9
 20000731    48  0.095  0.216  14.2
 20000731   100  0.113  0.224  16.5
 20000731   112  0.129  0.232  18.0
 20000731   124  0.143  0.240  18.9
 20000731   136  0.156  0.246  19.5
 20000731   148  0.171  0.247  19.8
 20000731   200  0.185  0.246  20.3
 20000731   212  0.197  0.243  20.9
 20000731   224  0.208  0.238  21.7
 20000731   236  0.215  0.231  22.6
 20000731   248  0.220  0.224  23.5
 20000731   300  0.223  0.214  24.4
 20000731   312  0.224  0.204  25.2
 20000731   324  0.223  0.191  26.2
 20000731   336  0.221  0.177  27.3
 20000731   348  0.217  0.161  28.7
 20000731   400  0.210  0.144  30.5
 20000731   412  0.202  0.126  33.0
 20000731   424  0.191  0.107  36.4
 20000731   436  0.179  0.086  41.6
 20000731   448  0.166  0.066  50.1
 20000731   500  0.152  0.048  66.6
 20000731   512  0.137  0.038  99.1
 20000731   524  0.120  0.044 136.5
 20000731   536  0.101  0.065 158.1
 20000731   548  0.074  0.090 169.2
```

Figure B-8. Excerpt from "wdm.tsd" file for Test Case 1. Station is Windmill Point, VA, USA.

Station 5: Baltimore

```
love point light
   39.0500  283.7167    0.0    6.1
12
Tide table tidal constituents
   DATE    TIME HEIGHT  SPEED  DIREC
 20000731    0   0.04   0.00    0.0
 20000731   12   0.02   0.00    0.0
 20000731   24   0.01   0.00    0.0
 20000731   36  -0.01   0.00    0.0
 20000731   48  -0.02   0.00    0.0
 20000731  100  -0.04   0.00    0.0
 20000731  112  -0.06   0.00    0.0
 20000731  124  -0.08   0.00    0.0
 20000731  136  -0.10   0.00    0.0
 20000731  148  -0.11   0.00    0.0
 20000731  200  -0.13   0.00    0.0
 20000731  212  -0.15   0.00    0.0
 20000731  224  -0.16   0.00    0.0
 20000731  236  -0.18   0.00    0.0
 20000731  248  -0.19   0.00    0.0
 20000731  300  -0.21   0.00    0.0
 20000731  312  -0.22   0.00    0.0
 20000731  324  -0.23   0.00    0.0
 20000731  336  -0.24   0.00    0.0
 20000731  348  -0.24   0.00    0.0
 20000731  400  -0.25   0.00    0.0
 20000731  412  -0.25   0.00    0.0
 20000731  424  -0.25   0.00    0.0
 20000731  436  -0.25   0.00    0.0
 20000731  448  -0.24   0.00    0.0
 20000731  500  -0.24   0.00    0.0
 20000731  512  -0.23   0.00    0.0
 20000731  524  -0.22   0.00    0.0
 20000731  536  -0.20   0.00    0.0
 20000731  548  -0.19   0.00    0.0
```

Figure B-9. Excerpt from "bal.thp" file for Test Case 1. Station is Love Point Light, MD, USA.

```
bal
   39.1500  283.6000    0.0    4.4
12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME  HEIGHT SPEED DIREC
 20000731    0   0.596  0.743 130.8
 20000731   12   0.607  0.757 130.8
 20000731   24   0.610  0.766 130.9
 20000731   36   0.607  0.770 130.9
 20000731   48   0.597  0.770 130.8
 20000731  100   0.577  0.766 130.7
 20000731  112   0.548  0.757 130.6
 20000731  124   0.508  0.740 130.5
 20000731  136   0.453  0.714 130.2
 20000731  148   0.383  0.682 129.8
 20000731  200   0.308  0.640 129.3
 20000731  212   0.203  0.585 128.9
 20000731  224   0.101  0.522 129.4
 20000731  236  -0.005  0.444 130.6
 20000731  248  -0.109  0.352 132.6
 20000731  300  -0.212  0.246 137.3
 20000731  312  -0.318  0.122 154.4
 20000731  324  -0.426  0.092 259.8
 20000731  336  -0.531  0.256 289.8
 20000731  348  -0.617  0.405 296.1
 20000731  400  -0.691  0.517 299.1
 20000731  412  -0.751  0.603 301.5
 20000731  424  -0.803  0.675 304.1
 20000731  436  -0.860  0.737 306.2
 20000731  448  -0.924  0.793 307.6
 20000731  500  -0.994  0.843 308.3
 20000731  512  -1.069  0.890 308.7
 20000731  524  -1.144  0.933 308.9
 20000731  536  -1.217  0.973 309.0
 20000731  548  -1.286  1.009 309.1
```

Figure B-10. Excerpt from "bal.tsd" file for Test Case 1. Station is Baltimore, MD, USA.

Station 6: Solomon's Island

```
Solomon's island
   38.3167  283.5500     0.0      0.0
12
Tide table tidal constituents
   DATE    TIME HEIGHT   SPEED   DIREC
 20000731    0  -0.23   0.00     0.0
 20000731   12  -0.23   0.00     0.0
 20000731   24  -0.23   0.00     0.0
 20000731   36  -0.23   0.00     0.0
 20000731   48  -0.22   0.00     0.0
 20000731  100  -0.22   0.00     0.0
 20000731  112  -0.21   0.00     0.0
 20000731  124  -0.20   0.00     0.0
 20000731  136  -0.18   0.00     0.0
 20000731  148  -0.17   0.00     0.0
 20000731  200  -0.15   0.00     0.0
 20000731  212  -0.13   0.00     0.0
 20000731  224  -0.11   0.00     0.0
 20000731  236  -0.09   0.00     0.0
 20000731  248  -0.07   0.00     0.0
 20000731  300  -0.05   0.00     0.0
 20000731  312  -0.02   0.00     0.0
 20000731  324   0.00   0.00     0.0
 20000731  336   0.02   0.00     0.0
 20000731  348   0.05   0.00     0.0
 20000731  400   0.07   0.00     0.0
 20000731  412   0.09   0.00     0.0
 20000731  424   0.12   0.00     0.0
 20000731  436   0.14   0.00     0.0
 20000731  448   0.16   0.00     0.0
 20000731  500   0.18   0.00     0.0
 20000731  512   0.19   0.00     0.0
 20000731  524   0.21   0.00     0.0
 20000731  536   0.22   0.00     0.0
 20000731  548   0.23   0.00     0.0
```

Figure B-11. Excerpt from "sol.thp" file for Test Case 1. Station is Solomon's Island, Maryland, USA.

```
sol
   38.3200  283.6150     0.0     8.3
12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME  HEIGHT SPEED DIREC
 20000731     0 -0.202  0.125 177.4
 20000731    12 -0.205  0.121 180.0
 20000731    24 -0.206  0.116 182.9
 20000731    36 -0.207  0.109 185.9
 20000731    48 -0.207  0.099 189.6
 20000731   100 -0.204  0.089 195.0
 20000731   112 -0.197  0.082 202.3
 20000731   124 -0.186  0.076 211.3
 20000731   136 -0.173  0.071 222.0
 20000731   148 -0.158  0.067 234.8
 20000731   200 -0.143  0.066 249.8
 20000731   212 -0.129  0.069 266.5
 20000731   224 -0.117  0.077 283.1
 20000731   236 -0.107  0.090 296.8
 20000731   248 -0.097  0.107 306.7
 20000731   300 -0.082  0.124 313.6
 20000731   312 -0.065  0.140 318.2
 20000731   324 -0.049  0.153 321.5
 20000731   336 -0.030  0.165 324.1
 20000731   348 -0.010  0.174 326.4
 20000731   400  0.011  0.182 328.4
 20000731   412  0.032  0.188 330.3
 20000731   424  0.053  0.191 331.7
 20000731   436  0.073  0.195 333.4
 20000731   448  0.091  0.201 336.1
 20000731   500  0.105  0.208 338.9
 20000731   512  0.115  0.213 341.1
 20000731   524  0.125  0.215 342.8
 20000731   536  0.136  0.215 344.4
 20000731   548  0.147  0.212 346.0
```

Figure B-12. Excerpt from "sol.tsd" file for Test Case 1. Station is Solomon's Island, Maryland, USA.

Station 7: Lewes

```
breakwater harbour
   38.7833  284.9000     0.0    11.2
12
Tide table tidal constituents
   DATE    TIME HEIGHT   SPEED   DIREC
 20000731     0    0.90   0.00     0.0
 20000731    12    0.93   0.00     0.0
 20000731    24    0.96   0.00     0.0
 20000731    36    0.98   0.00     0.0
 20000731    48    0.98   0.00     0.0
 20000731   100    0.98   0.00     0.0
 20000731   112    0.98   0.00     0.0
 20000731   124    0.96   0.00     0.0
 20000731   136    0.93   0.00     0.0
 20000731   148    0.90   0.00     0.0
 20000731   200    0.86   0.00     0.0
 20000731   212    0.81   0.00     0.0
 20000731   224    0.75   0.00     0.0
 20000731   236    0.69   0.00     0.0
 20000731   248    0.62   0.00     0.0
 20000731   300    0.55   0.00     0.0
 20000731   312    0.47   0.00     0.0
 20000731   324    0.39   0.00     0.0
 20000731   336    0.31   0.00     0.0
 20000731   348    0.22   0.00     0.0
 20000731   400    0.13   0.00     0.0
 20000731   412    0.05   0.00     0.0
 20000731   424   -0.04   0.00     0.0
 20000731   436   -0.13   0.00     0.0
 20000731   448   -0.21   0.00     0.0
 20000731   500   -0.29   0.00     0.0
 20000731   512   -0.37   0.00     0.0
 20000731   524   -0.44   0.00     0.0
 20000731   536   -0.51   0.00     0.0
 20000731   548   -0.57   0.00     0.0
```

Figure B-13. Excerpt from "lew.thp" file for Test Case 1. Station is Breakwater Harbour, DE, USA.

```
lew
   38.7800  284.8800     0.0     7.5
12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME  HEIGHT SPEED DIREC
 20000731     0  0.842  0.398 291.8
 20000731    12  0.877  0.391 289.6
 20000731    24  0.905  0.381 287.4
 20000731    36  0.924  0.370 285.2
 20000731    48  0.936  0.358 282.9
 20000731   100  0.939  0.344 280.7
 20000731   112  0.934  0.328 278.5
 20000731   124  0.922  0.312 276.3
 20000731   136  0.901  0.293 274.0
 20000731   148  0.872  0.273 271.3
 20000731   200  0.834  0.250 268.3
 20000731   212  0.790  0.224 264.7
 20000731   224  0.738  0.197 260.1
 20000731   236  0.679  0.166 254.7
 20000731   248  0.614  0.134 248.2
 20000731   300  0.545  0.104 240.3
 20000731   312  0.472  0.080 225.7
 20000731   324  0.396  0.070 198.1
 20000731   336  0.317  0.078 168.2
 20000731   348  0.235  0.102 148.8
 20000731   400  0.153  0.137 138.8
 20000731   412  0.072  0.178 134.4
 20000731   424 -0.007  0.220 133.3
 20000731   436 -0.079  0.253 132.0
 20000731   448 -0.155  0.281 128.9
 20000731   500 -0.237  0.305 128.1
 20000731   512 -0.310  0.326 127.8
 20000731   524 -0.379  0.344 126.5
 20000731   536 -0.444  0.362 123.6
 20000731   548 -0.507  0.371 121.1
```

Figure B-14. Excerpt from "lew.tsd" file for Test Case 1. Station is Lewes, DE, USA.

Test Case 2 Model Output Data

The following figures represent the first thirty lines of code from the ".thp" and ".tsd" files generated by the PCTides test run with winds, Test Case 2.

Station 1: Port Angeles

```
port angeles
   48.1333  236.5667    0.0    10.6
12
Tide table tidal constituents
   DATE    TIME HEIGHT  SPEED  DIREC
 20020208    0  -1.12   0.00    0.0
 20020208   12  -1.19   0.00    0.0
 20020208   24  -1.25   0.00    0.0
 20020208   36  -1.30   0.00    0.0
 20020208   48  -1.35   0.00    0.0
 20020208  100  -1.39   0.00    0.0
 20020208  112  -1.42   0.00    0.0
 20020208  124  -1.45   0.00    0.0
 20020208  136  -1.46   0.00    0.0
 20020208  148  -1.47   0.00    0.0
 20020208  200  -1.48   0.00    0.0
 20020208  212  -1.47   0.00    0.0
 20020208  224  -1.46   0.00    0.0
 20020208  236  -1.44   0.00    0.0
 20020208  248  -1.42   0.00    0.0
 20020208  300  -1.39   0.00    0.0
 20020208  312  -1.35   0.00    0.0
 20020208  324  -1.30   0.00    0.0
 20020208  336  -1.25   0.00    0.0
 20020208  348  -1.19   0.00    0.0
 20020208  400  -1.13   0.00    0.0
 20020208  412  -1.07   0.00    0.0
 20020208  424  -1.00   0.00    0.0
 20020208  436  -0.92   0.00    0.0
 20020208  448  -0.85   0.00    0.0
 20020208  500  -0.77   0.00    0.0
 20020208  512  -0.69   0.00    0.0
 20020208  524  -0.61   0.00    0.0
 20020208  536  -0.52   0.00    0.0
 20020208  548  -0.44   0.00    0.0
```

Figure B-15. Excerpt from "ang.thp" file for Test Case 2. Station is Port Angeles, Washington, USA.

```
ang
   48.1850  236.5700    0.0  113.3
12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME  HEIGHT SPEED DIREC
 20020208     0 -1.078  0.667 277.3
 20020208    12 -1.137  0.660 277.2
 20020208    24 -1.189  0.649 277.2
 20020208    36 -1.235  0.633 277.2
 20020208    48 -1.273  0.611 277.1
 20020208   100 -1.305  0.584 277.1
 20020208   112 -1.332  0.556 277.1
 20020208   124 -1.354  0.526 277.1
 20020208   136 -1.367  0.492 277.1
 20020208   148 -1.369  0.453 277.1
 20020208   200 -1.368  0.411 277.1
 20020208   212 -1.360  0.367 277.0
 20020208   224 -1.346  0.322 277.0
 20020208   236 -1.325  0.275 277.1
 20020208   248 -1.298  0.225 277.3
 20020208   300 -1.266  0.174 277.6
 20020208   312 -1.230  0.123 278.3
 20020208   324 -1.189  0.071 279.7
 20020208   336 -1.143  0.019 289.7
 20020208   348 -1.091  0.035  88.3
 20020208   400 -1.035  0.089  92.4
 20020208   412 -0.980  0.142  93.3
 20020208   424 -0.922  0.192  93.5
 20020208   436 -0.861  0.241  93.6
 20020208   448 -0.802  0.286  93.6
 20020208   500 -0.735  0.330  93.7
 20020208   512 -0.666  0.371  93.7
 20020208   524 -0.598  0.409  93.6
 20020208   536 -0.531  0.441  93.5
 20020208   548 -0.465  0.468  93.3
```

Figure B-16. Excerpt from "ang.tsd" file for Test Case 2. Station is Port Angeles, Washington, USA.

Test Case 3 Model Output Data

The following figures represent the first thirty lines of code from the ".thp" and ".tsd" files generated for the stations included in the coarse resolution portion of Test Case 3.

Station 1: Aberdeen

```
aberdeen
   57.1500  357.9167    0.0   17.4        12
Tide table tidal constituents
  DATE    TIME HEIGHT  SPEED  DIREC
 20000731    0    1.81   0.00    0.0
 20000731   12    1.88   0.00    0.0
 20000731   24    1.93   0.00    0.0
 20000731   36    1.97   0.00    0.0
 20000731   48    1.99   0.00    0.0
 20000731  100    1.98   0.00    0.0
 20000731  112    1.96   0.00    0.0
 20000731  124    1.92   0.00    0.0
 20000731  136    1.86   0.00    0.0
 20000731  148    1.79   0.00    0.0
 20000731  200    1.69   0.00    0.0
 20000731  212    1.58   0.00    0.0
 20000731  224    1.45   0.00    0.0
 20000731  236    1.31   0.00    0.0
 20000731  248    1.16   0.00    0.0
 20000731  300    1.00   0.00    0.0
 20000731  312    0.82   0.00    0.0
 20000731  324    0.64   0.00    0.0
 20000731  336    0.45   0.00    0.0
 20000731  348    0.26   0.00    0.0
 20000731  400    0.06   0.00    0.0
 20000731  412   -0.13   0.00    0.0
 20000731  424   -0.33   0.00    0.0
 20000731  436   -0.52   0.00    0.0
 20000731  448   -0.71   0.00    0.0
 20000731  500   -0.88   0.00    0.0
 20000731  512   -1.05   0.00    0.0
 20000731  524   -1.21   0.00    0.0
 20000731  536   -1.36   0.00    0.0
 20000731  548   -1.49   0.00    0.0
```

Figure B-17. Excerpt from "abe_c.thp" file for Test Case 3. Station is Aberdeen, UK.

```
abe
   57.1450  357.9202    0.0    7.0        12
 DATA FROM THE REGIONAL OCEAN MODEL
  DATE    TIME   HEIGHT SPEED DIREC
 20000731    0   1.491  0.209 272.2
 20000731   12   1.535  0.198 281.0
 20000731   24   1.567  0.190 290.3
 20000731   36   1.581  0.184 300.9
 20000731   48   1.582  0.184 311.7
 20000731  100   1.567  0.190 322.1
 20000731  112   1.539  0.199 331.9
 20000731  124   1.495  0.212 341.0
 20000731  136   1.436  0.228 349.4
 20000731  148   1.360  0.246 357.0
 20000731  200   1.271  0.263   3.5
 20000731  212   1.171  0.280   9.0
 20000731  224   1.061  0.296  13.7
 20000731  236   0.943  0.310  17.7
 20000731  248   0.814  0.324  21.4
 20000731  300   0.675  0.338  25.1
 20000731  312   0.527  0.352  28.7
 20000731  324   0.374  0.361  32.5
 20000731  336   0.217  0.364  36.6
 20000731  348   0.056  0.366  41.0
 20000731  400  -0.107  0.367  45.6
 20000731  412  -0.271  0.366  50.6
 20000731  424  -0.435  0.365  55.8
 20000731  436  -0.596  0.365  61.0
 20000731  448  -0.749  0.363  66.1
 20000731  500  -0.894  0.360  70.9
 20000731  512  -1.029  0.356  75.7
 20000731  524  -1.154  0.352  80.6
 20000731  536  -1.268  0.348  85.0
 20000731  548  -1.370  0.343  89.4
```

Figure B-18. Excerpt from "abe_c.tsd " file for Test Case 3. Station is Aberdeen, UK.

Station 2: Dover

```
folkestone
   51.0833     1.1833     0.0     0.0          12
Tide table tidal constituents
   DATE    TIME HEIGHT   SPEED   DIREC
 20000731    0    2.54    0.00     0.0
 20000731   12    2.36    0.00     0.0
 20000731   24    2.16    0.00     0.0
 20000731   36    1.96    0.00     0.0
 20000731   48    1.75    0.00     0.0
 20000731  100    1.53    0.00     0.0
 20000731  112    1.31    0.00     0.0
 20000731  124    1.09    0.00     0.0
 20000731  136    0.86    0.00     0.0
 20000731  148    0.63    0.00     0.0
 20000731  200    0.40    0.00     0.0
 20000731  212    0.17    0.00     0.0
 20000731  224   -0.06    0.00     0.0
 20000731  236   -0.30    0.00     0.0
 20000731  248   -0.54    0.00     0.0
 20000731  300   -0.79    0.00     0.0
 20000731  312   -1.04    0.00     0.0
 20000731  324   -1.28    0.00     0.0
 20000731  336   -1.53    0.00     0.0
 20000731  348   -1.78    0.00     0.0
 20000731  400   -2.02    0.00     0.0
 20000731  412   -2.26    0.00     0.0
 20000731  424   -2.48    0.00     0.0
 20000731  436   -2.69    0.00     0.0
 20000731  448   -2.89    0.00     0.0
 20000731  500   -3.06    0.00     0.0
 20000731  512   -3.20    0.00     0.0
 20000731  524   -3.31    0.00     0.0
 20000731  536   -3.39    0.00     0.0
 20000731  548   -3.43    0.00     0.0
```

Figure B-19. Excerpt from "dov_c.thp " file for Test Case 3. Station is Folkstone, UK.

```
dov
   51.0400     1.3000     0.0     5.9          12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME   HEIGHT SPEED DIREC
 20000731    0  0.653  0.000    1.8
 20000731   12  0.612  0.000    1.8
 20000731   24  0.570  0.000    1.8
 20000731   36  0.514  0.000    1.8
 20000731   48  0.461  0.000    1.8
 20000731  100  0.000  0.000    1.8
 20000731  112  0.358  0.000    1.8
 20000731  124  0.306  0.000    1.8
 20000731  136  0.256  0.000    1.8
 20000731  148  0.204  0.000    1.8
 20000731  200  0.000  0.000    1.8
 20000731  212  0.087  0.000    1.8
 20000731  224  0.021  0.000    1.8
 20000731  236 -0.049  0.000    1.8
 20000731  248 -0.125  0.000    1.8
 20000731  300  0.000  0.000    1.8
 20000731  312 -0.289  0.000    1.8
 20000731  324 -0.372  0.000    1.8
 20000731  336 -0.453  0.000    1.8
 20000731  348 -0.533  0.000    1.8
 20000731  400  0.000  0.000    1.8
 20000731  412 -0.688  0.000    1.8
 20000731  424 -0.761  0.000    1.8
 20000731  436 -0.828  0.000    1.8
 20000731  448 -0.889  0.000    1.8
 20000731  500  0.000  0.000    1.8
 20000731  512 -0.984  0.000    1.8
 20000731  524 -1.016  0.000    1.8
 20000731  536 -1.035  0.000    1.8
 20000731  548 -1.041  0.000    1.8
```

Figure B-20. Excerpt from "dov_c.tsd " file for Test Case 3. Station is Dover, UK.

Station 3: Heysham

```
barrow in furness
   54.1000  356.8000    0.0     0.0        12
Tide table tidal constituents
   DATE   TIME HEIGHT   SPEED   DIREC
 20000731    0    3.77   0.00    0.0
 20000731   12    3.50   0.00    0.0
 20000731   24    3.21   0.00    0.0
 20000731   36    2.88   0.00    0.0
 20000731   48    2.54   0.00    0.0
 20000731  100    2.18   0.00    0.0
 20000731  112    1.81   0.00    0.0
 20000731  124    1.43   0.00    0.0
 20000731  136    1.04   0.00    0.0
 20000731  148    0.66   0.00    0.0
 20000731  200    0.27   0.00    0.0
 20000731  212   -0.11   0.00    0.0
 20000731  224   -0.48   0.00    0.0
 20000731  236   -0.84   0.00    0.0
 20000731  248   -1.19   0.00    0.0
 20000731  300   -1.53   0.00    0.0
 20000731  312   -1.85   0.00    0.0
 20000731  324   -2.16   0.00    0.0
 20000731  336   -2.45   0.00    0.0
 20000731  348   -2.72   0.00    0.0
 20000731  400   -2.97   0.00    0.0
 20000731  412   -3.20   0.00    0.0
 20000731  424   -3.40   0.00    0.0
 20000731  436   -3.58   0.00    0.0
 20000731  448   -3.72   0.00    0.0
 20000731  500   -3.84   0.00    0.0
 20000731  512   -3.93   0.00    0.0
 20000731  524   -3.98   0.00    0.0
 20000731  536   -3.99   0.00    0.0
 20000731  548   -3.97   0.00    0.0
```

Figure B-21. Excerpt from "hey_c.thp " file for Test Case 3. Station is Barrow-in-Furness, UK.

```
hey
   54.0300  356.6000    0.0   11.2        12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE   TIME  HEIGHT SPEED DIREC
 20000731    0  2.782  0.000 359.8
 20000731   12  2.581  0.000 359.8
 20000731   24  2.361  0.000 359.8
 20000731   36  2.126  0.000 359.8
 20000731   48  1.876  0.000 359.8
 20000731  100  1.616  0.000 359.8
 20000731  112  1.347  0.000 359.8
 20000731  124  1.072  0.000 359.8
 20000731  136  0.791  0.000 359.8
 20000731  148  0.508  0.000 359.8
 20000731  200  0.224  0.000 359.8
 20000731  212 -0.057  0.000 359.8
 20000731  224 -0.335  0.000 359.8
 20000731  236 -0.608  0.000 359.8
 20000731  248 -0.877  0.000 359.8
 20000731  300 -1.141  0.000 359.8
 20000731  312 -1.400  0.000 359.8
 20000731  324 -1.650  0.000 359.8
 20000731  336 -1.892  0.000 359.8
 20000731  348 -2.122  0.000 359.8
 20000731  400 -2.338  0.000 359.8
 20000731  412 -2.537  0.000 359.8
 20000731  424 -2.719  0.000 359.8
 20000731  436 -2.880  0.000 359.8
 20000731  448 -3.018  0.000 359.8
 20000731  500 -3.131  0.000 359.8
 20000731  512 -3.215  0.000 359.8
 20000731  524 -3.270  0.000 359.8
 20000731  536 -3.293  0.000 359.8
 20000731  548 -3.284  0.000 359.8
```

Figure B-22. Excerpt from "hey_c.tsd " file for Test Case 3. Station is Heysham, UK.

Station 4: Immingham

```
hull saltend
   53.7333  359.7500    0.0    4.0         12
Tide table tidal constituents
   DATE    TIME HEIGHT  SPEED  DIREC
 20000731    0  -2.88   0.00    0.0
 20000731   12  -2.83   0.00    0.0
 20000731   24  -2.74   0.00    0.0
 20000731   36  -2.62   0.00    0.0
 20000731   48  -2.48   0.00    0.0
 20000731  100  -2.31   0.00    0.0
 20000731  112  -2.11   0.00    0.0
 20000731  124  -1.89   0.00    0.0
 20000731  136  -1.65   0.00    0.0
 20000731  148  -1.39   0.00    0.0
 20000731  200  -1.11   0.00    0.0
 20000731  212  -0.82   0.00    0.0
 20000731  224  -0.52   0.00    0.0
 20000731  236  -0.21   0.00    0.0
 20000731  248   0.10   0.00    0.0
 20000731  300   0.41   0.00    0.0
 20000731  312   0.72   0.00    0.0
 20000731  324   1.02   0.00    0.0
 20000731  336   1.31   0.00    0.0
 20000731  348   1.60   0.00    0.0
 20000731  400   1.86   0.00    0.0
 20000731  412   2.11   0.00    0.0
 20000731  424   2.34   0.00    0.0
 20000731  436   2.55   0.00    0.0
 20000731  448   2.73   0.00    0.0
 20000731  500   2.88   0.00    0.0
 20000731  512   3.01   0.00    0.0
 20000731  524   3.10   0.00    0.0
 20000731  536   3.17   0.00    0.0
 20000731  548   3.20   0.00    0.0
```

Figure B-23. Excerpt from "imm_c.thp " file for Test Case 3. Station is Hull Saltend, UK.

```
imm
   53.6300  359.9101    0.0    3.6         12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME  HEIGHT SPEED DIREC
 20000731    0 -1.100  1.037 301.7
 20000731   12 -1.127  1.017 302.6
 20000731   24 -1.143  0.989 303.9
 20000731   36 -1.146  0.955 305.3
 20000731   48 -1.139  0.911 306.6
 20000731  100 -1.118  0.860 307.8
 20000731  112 -1.084  0.802 309.4
 20000731  124 -1.037  0.736 311.2
 20000731  136 -0.984  0.656 312.4
 20000731  148 -0.918  0.553 311.7
 20000731  200 -0.832  0.441 310.8
 20000731  212 -0.739  0.321 310.7
 20000731  224 -0.634  0.188 310.5
 20000731  236 -0.487  0.045 294.5
 20000731  248 -0.327  0.124 143.1
 20000731  300 -0.174  0.266 141.9
 20000731  312 -0.028  0.379 141.2
 20000731  324  0.138  0.467 139.5
 20000731  336  0.295  0.544 138.2
 20000731  348  0.443  0.617 137.4
 20000731  400  0.579  0.689 136.4
 20000731  412  0.702  0.757 135.1
 20000731  424  0.813  0.822 133.5
 20000731  436  0.912  0.882 131.7
 20000731  448  1.000  0.939 130.0
 20000731  500  1.077  0.990 128.5
 20000731  512  1.142  1.036 127.1
 20000731  524  1.195  1.076 125.9
 20000731  536  1.238  1.108 124.8
 20000731  548  1.265  1.133 123.5
```

Figure B-24. Excerpt from "imm_c.tsd " file for Test Case 3. Station is Immingham, UK.

Station 5: Lerwick

```
lerwick
   60.1500  358.8667    0.0   28.7          12
Tide table tidal constituents
   DATE    TIME HEIGHT  SPEED  DIREC
 20000731    0    0.64  0.00    0.0
 20000731   12    0.57  0.00    0.0
 20000731   24    0.50  0.00    0.0
 20000731   36    0.42  0.00    0.0
 20000731   48    0.34  0.00    0.0
 20000731  100    0.25  0.00    0.0
 20000731  112    0.16  0.00    0.0
 20000731  124    0.07  0.00    0.0
 20000731  136   -0.02  0.00    0.0
 20000731  148   -0.11  0.00    0.0
 20000731  200   -0.20  0.00    0.0
 20000731  212   -0.28  0.00    0.0
 20000731  224   -0.37  0.00    0.0
 20000731  236   -0.45  0.00    0.0
 20000731  248   -0.52  0.00    0.0
 20000731  300   -0.59  0.00    0.0
 20000731  312   -0.66  0.00    0.0
 20000731  324   -0.71  0.00    0.0
 20000731  336   -0.76  0.00    0.0
 20000731  348   -0.80  0.00    0.0
 20000731  400   -0.84  0.00    0.0
 20000731  412   -0.86  0.00    0.0
 20000731  424   -0.88  0.00    0.0
 20000731  436   -0.89  0.00    0.0
 20000731  448   -0.89  0.00    0.0
 20000731  500   -0.88  0.00    0.0
 20000731  512   -0.86  0.00    0.0
 20000731  524   -0.83  0.00    0.0
 20000731  536   -0.79  0.00    0.0
 20000731  548   -0.75  0.00    0.0
```

Figure B-25. Excerpt from "ler_c.thp " file for Test Case 3. Station is Lerwick, UK.

```
ler
   60.1600  358.7500    0.0    7.4          12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME   HEIGHT SPEED DIREC
 20000731    0   0.498  0.285 270.7
 20000731   12   0.483  0.279 270.7
 20000731   24   0.462  0.271 270.7
 20000731   36   0.437  0.259 270.7
 20000731   48   0.420  0.242 270.7
 20000731  100   0.390  0.221 270.7
 20000731  112   0.354  0.201 270.7
 20000731  124   0.315  0.178 270.7
 20000731  136   0.273  0.155 270.7
 20000731  148   0.233  0.128 270.7
 20000731  200   0.186  0.101 270.7
 20000731  212   0.139  0.075 270.7
 20000731  224   0.094  0.048 270.7
 20000731  236   0.047  0.019 270.7
 20000731  248   0.005  0.013  90.7
 20000731  300  -0.041  0.045  90.7
 20000731  312  -0.085  0.075  90.7
 20000731  324  -0.126  0.107  90.7
 20000731  336  -0.166  0.138  90.7
 20000731  348  -0.205  0.169  90.7
 20000731  400  -0.240  0.198  90.7
 20000731  412  -0.271  0.226  90.7
 20000731  424  -0.300  0.253  90.7
 20000731  436  -0.326  0.278  90.7
 20000731  448  -0.348  0.302  90.7
 20000731  500  -0.366  0.324  90.7
 20000731  512  -0.382  0.343  90.7
 20000731  524  -0.394  0.359  90.7
 20000731  536  -0.402  0.371  90.7
 20000731  548  -0.405  0.380  90.7
```

Figure B-26. Excerpt from "ler_c.tsd " file for Test Case 3. Station is Lerwick, UK.

Station 6: Liverpool

```
new brighton
   53.4333  356.9500    0.0     0.0          12
Tide table tidal constituents
   DATE    TIME HEIGHT  SPEED   DIREC
 20000731     0   2.92   0.00    0.0
 20000731    12   2.62   0.00    0.0
 20000731    24   2.31   0.00    0.0
 20000731    36   1.98   0.00    0.0
 20000731    48   1.64   0.00    0.0
 20000731   100   1.30   0.00    0.0
 20000731   112   0.95   0.00    0.0
 20000731   124   0.59   0.00    0.0
 20000731   136   0.24   0.00    0.0
 20000731   148  -0.12   0.00    0.0
 20000731   200  -0.47   0.00    0.0
 20000731   212  -0.82   0.00    0.0
 20000731   224  -1.16   0.00    0.0
 20000731   236  -1.50   0.00    0.0
 20000731   248  -1.83   0.00    0.0
 20000731   300  -2.16   0.00    0.0
 20000731   312  -2.47   0.00    0.0
 20000731   324  -2.76   0.00    0.0
 20000731   336  -3.04   0.00    0.0
 20000731   348  -3.30   0.00    0.0
 20000731   400  -3.54   0.00    0.0
 20000731   412  -3.76   0.00    0.0
 20000731   424  -3.94   0.00    0.0
 20000731   436  -4.09   0.00    0.0
 20000731   448  -4.20   0.00    0.0
 20000731   500  -4.28   0.00    0.0
 20000731   512  -4.31   0.00    0.0
 20000731   524  -4.30   0.00    0.0
 20000731   536  -4.23   0.00    0.0
 20000731   548  -4.13   0.00    0.0
```

Figure B-27. Excerpt from "liv_c.thp " file for Test Case 3. Station is New Brighton, UK.

```
liv
   53.5000  356.6502    0.0   12.3           12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME  HEIGHT SPEED DIREC
 20000731     0   4.151 1.497 310.6
 20000731    12   3.751 1.487 308.7
 20000731    24   3.326 1.467 306.9
 20000731    36   2.879 1.438 305.0
 20000731    48   2.414 1.401 302.9
 20000731   100   1.933 1.357 300.7
 20000731   112   1.441 1.307 298.2
 20000731   124   0.940 1.254 295.3
 20000731   136   0.430 1.200 291.9
 20000731   148  -0.089 1.146 288.0
 20000731   200  -0.617 1.094 283.5
 20000731   212  -1.153 1.045 278.4
 20000731   224  -1.692 1.001 272.6
 20000731   236  -2.236 0.964 266.0
 20000731   248  -2.783 0.935 258.9
 20000731   300  -3.337 0.918 251.1
 20000731   312  -3.893 0.910 242.7
 20000731   324  -4.444 0.910 233.8
 20000731   336  -4.982 0.916 224.4
 20000731   348  -5.497 0.931 214.4
 20000731   400  -5.981 0.957 204.0
 20000731   412  -6.425 1.000 193.4
 20000731   424  -6.821 1.062 183.0
 20000731   436  -7.164 1.147 173.5
 20000731   448  -7.445 1.248 165.4
 20000731   500  -7.656 1.354 158.9
 20000731   512  -7.794 1.453 154.0
 20000731   524  -7.857 1.542 150.1
 20000731   536  -7.828 1.618 147.0
 20000731   548  -7.702 1.681 144.3
```

Figure B-28. Excerpt from "liv_c.tsd " file for Test Case 3. Station is Liverpool, UK.

Station 7: Newport

```
eastbourne
   50.7667     0.2833     0.0     0.0          12
Tide table tidal constituents
   DATE    TIME HEIGHT  SPEED  DIREC
 20000731    0    3.13   0.00    0.0
 20000731   12    2.92   0.00    0.0
 20000731   24    2.68   0.00    0.0
 20000731   36    2.42   0.00    0.0
 20000731   48    2.14   0.00    0.0
 20000731  100    1.84   0.00    0.0
 20000731  112    1.52   0.00    0.0
 20000731  124    1.19   0.00    0.0
 20000731  136    0.85   0.00    0.0
 20000731  148    0.51   0.00    0.0
 20000731  200    0.16   0.00    0.0
 20000731  212   -0.19   0.00    0.0
 20000731  224   -0.53   0.00    0.0
 20000731  236   -0.88   0.00    0.0
 20000731  248   -1.21   0.00    0.0
 20000731  300   -1.54   0.00    0.0
 20000731  312   -1.85   0.00    0.0
 20000731  324   -2.15   0.00    0.0
 20000731  336   -2.44   0.00    0.0
 20000731  348   -2.70   0.00    0.0
 20000731  400   -2.94   0.00    0.0
 20000731  412   -3.15   0.00    0.0
 20000731  424   -3.33   0.00    0.0
 20000731  436   -3.49   0.00    0.0
 20000731  448   -3.61   0.00    0.0
 20000731  500   -3.70   0.00    0.0
 20000731  512   -3.75   0.00    0.0
 20000731  524   -3.76   0.00    0.0
 20000731  536   -3.73   0.00    0.0
 20000731  548   -3.66   0.00    0.0
```

Figure B-29. Excerpt from "new_c.thp " file for Test Case 3. Station is Eastbourne, UK.

```
new
   50.6500     0.0500     0.0    6.1          12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME  HEIGHT SPEED DIREC
 20000731     0  1.947  0.134 271.3
 20000731    12  1.777  0.169 271.3
 20000731    24  1.590  0.200 271.3
 20000731    36  1.389  0.227 271.3
 20000731    48  1.175  0.252 271.3
 20000731   100  0.948  0.274 271.3
 20000731   112  0.709  0.295 271.3
 20000731   124  0.460  0.313 271.3
 20000731   136  0.205  0.331 271.3
 20000731   148 -0.054  0.349 271.3
 20000731   200 -0.309  0.367 271.3
 20000731   212 -0.559  0.385 271.3
 20000731   224 -0.803  0.400 271.3
 20000731   236 -1.037  0.413 271.3
 20000731   248 -1.271  0.423 271.3
 20000731   300 -1.490  0.429 271.3
 20000731   312 -1.687  0.434 271.3
 20000731   324 -1.862  0.436 271.3
 20000731   336 -2.020  0.437 271.3
 20000731   348 -2.159  0.435 271.3
 20000731   400 -2.279  0.431 271.3
 20000731   412 -2.380  0.424 271.3
 20000731   424 -2.462  0.412 271.3
 20000731   436 -2.523  0.393 271.3
 20000731   448 -2.562  0.367 271.3
 20000731   500 -2.578  0.334 271.3
 20000731   512 -2.572  0.294 271.3
 20000731   524 -2.542  0.248 271.3
 20000731   536 -2.486  0.195 271.3
 20000731   548 -2.402  0.135 271.3
```

Figure B-30. Excerpt from "new_c.tsd " file for Test Case 3. Station is Newport, UK.

Station 8: Sheerness

```
coryton
  51.5333     0.5167    0.0     0.0          12
Tide table tidal constituents
  DATE     TIME HEIGHT  SPEED  DIREC
 20000731    0    2.59   0.00    0.0
 20000731   12    2.60   0.00    0.0
 20000731   24    2.59   0.00    0.0
 20000731   36    2.55   0.00    0.0
 20000731   48    2.49   0.00    0.0
 20000731  100    2.40   0.00    0.0
 20000731  112    2.29   0.00    0.0
 20000731  124    2.15   0.00    0.0
 20000731  136    1.99   0.00    0.0
 20000731  148    1.81   0.00    0.0
 20000731  200    1.62   0.00    0.0
 20000731  212    1.40   0.00    0.0
 20000731  224    1.18   0.00    0.0
 20000731  236    0.94   0.00    0.0
 20000731  248    0.69   0.00    0.0
 20000731  300    0.43   0.00    0.0
 20000731  312    0.17   0.00    0.0
 20000731  324   -0.09   0.00    0.0
 20000731  336   -0.35   0.00    0.0
 20000731  348   -0.61   0.00    0.0
 20000731  400   -0.86   0.00    0.0
 20000731  412   -1.10   0.00    0.0
 20000731  424   -1.33   0.00    0.0
 20000731  436   -1.54   0.00    0.0
 20000731  448   -1.74   0.00    0.0
 20000731  500   -1.92   0.00    0.0
 20000731  512   -2.08   0.00    0.0
 20000731  524   -2.22   0.00    0.0
 20000731  536   -2.34   0.00    0.0
 20000731  548   -2.43   0.00    0.0
```

Figure B-31. Excerpt from "she_c.thp " file for Test Case 3. Station is Coryton, UK.

```
she
  51.4674     0.7833     0.0     2.7          12
 DATA FROM THE REGIONAL OCEAN MODEL
  DATE     TIME   HEIGHT SPEED DIREC
 20000731    0   1.354  1.052 230.9
 20000731   12   1.497  1.012 229.0
 20000731   24   1.591  0.970 227.6
 20000731   36   1.678  0.920 226.1
 20000731   48   1.756  0.863 224.4
 20000731  100   1.819  0.798 222.2
 20000731  112   1.862  0.728 219.3
 20000731  124   1.886  0.654 215.4
 20000731  136   1.893  0.576 210.2
 20000731  148   1.880  0.495 203.1
 20000731  200   1.849  0.421 193.0
 20000731  212   1.809  0.361 178.5
 20000731  224   1.752  0.318 157.1
 20000731  236   1.672  0.325 131.2
 20000731  248   1.584  0.387 109.7
 20000731  300   1.488  0.477  95.8
 20000731  312   1.381  0.572  87.1
 20000731  324   1.258  0.653  81.6
 20000731  336   1.134  0.720  77.6
 20000731  348   1.011  0.776  74.4
 20000731  400   0.868  0.825  71.8
 20000731  412   0.693  0.867  69.9
 20000731  424   0.543  0.900  67.3
 20000731  436   0.373  0.927  65.1
 20000731  448   0.239  0.952  62.5
 20000731  500   0.104  0.974  60.0
 20000731  512  -0.032  0.996  57.5
 20000731  524  -0.158  1.010  55.8
 20000731  536  -0.272  1.017  54.6
 20000731  548  -0.377  1.018  53.6
```

Figure B-32. Excerpt from "she_c.tsd " file for Test Case 3. Station is Sheerness, UK.

Station 9: Stornoway

```
stornoway
   58.2000  353.6167    0.0     0.0         12
Tide table tidal constituents
   DATE    TIME HEIGHT   SPEED   DIREC
 20000731     0   -1.89   0.00    0.0
 20000731    12   -1.96   0.00    0.0
 20000731    24   -2.01   0.00    0.0
 20000731    36   -2.04   0.00    0.0
 20000731    48   -2.04   0.00    0.0
 20000731   100   -2.03   0.00    0.0
 20000731   112   -1.99   0.00    0.0
 20000731   124   -1.93   0.00    0.0
 20000731   136   -1.86   0.00    0.0
 20000731   148   -1.76   0.00    0.0
 20000731   200   -1.65   0.00    0.0
 20000731   212   -1.52   0.00    0.0
 20000731   224   -1.37   0.00    0.0
 20000731   236   -1.21   0.00    0.0
 20000731   248   -1.04   0.00    0.0
 20000731   300   -0.86   0.00    0.0
 20000731   312   -0.66   0.00    0.0
 20000731   324   -0.47   0.00    0.0
 20000731   336   -0.26   0.00    0.0
 20000731   348   -0.06   0.00    0.0
 20000731   400    0.15   0.00    0.0
 20000731   412    0.35   0.00    0.0
 20000731   424    0.55   0.00    0.0
 20000731   436    0.74   0.00    0.0
 20000731   448    0.93   0.00    0.0
 20000731   500    1.10   0.00    0.0
 20000731   512    1.26   0.00    0.0
 20000731   524    1.41   0.00    0.0
 20000731   536    1.55   0.00    0.0
 20000731   548    1.66   0.00    0.0
```

Figure B-33. Excerpt from "sto_c.thp " file for Test Case 3. Station is Stornoway, UK.

```
sto
   58.2100  353.6600    0.0   15.4          12
 DATA FROM THE REGIONAL OCEAN MODEL
   DATE    TIME   HEIGHT SPEED DIREC
 20000731     0 -1.839  0.086 207.2
 20000731    12 -1.905  0.091 206.4
 20000731    24 -1.951  0.095 206.1
 20000731    36 -1.981  0.098 205.8
 20000731    48 -1.989  0.102 205.0
 20000731   100 -1.975  0.104 205.1
 20000731   112 -1.939  0.103 205.5
 20000731   124 -1.877  0.100 204.9
 20000731   136 -1.804  0.095 204.1
 20000731   148 -1.712  0.088 205.4
 20000731   200 -1.601  0.078 207.0
 20000731   212 -1.465  0.069 208.2
 20000731   224 -1.325  0.057 208.6
 20000731   236 -1.173  0.043 209.9
 20000731   248 -1.006  0.029 212.4
 20000731   300 -0.827  0.015 224.1
 20000731   312 -0.639  0.005 307.7
 20000731   324 -0.447  0.019  11.1
 20000731   336 -0.254  0.037  20.8
 20000731   348 -0.059  0.055  24.8
 20000731   400  0.127  0.072  29.7
 20000731   412  0.314  0.088  30.8
 20000731   424  0.500  0.106  30.4
 20000731   436  0.677  0.122  31.3
 20000731   448  0.840  0.138  33.1
 20000731   500  0.986  0.152  35.1
 20000731   512  1.120  0.164  36.8
 20000731   524  1.245  0.177  38.0
 20000731   536  1.351  0.188  38.6
 20000731   548  1.444  0.199  39.0
```

Figure B-34. Excerpt from "sto_c.tsd " file for Test Case 3. Station is Stornoway, UK.